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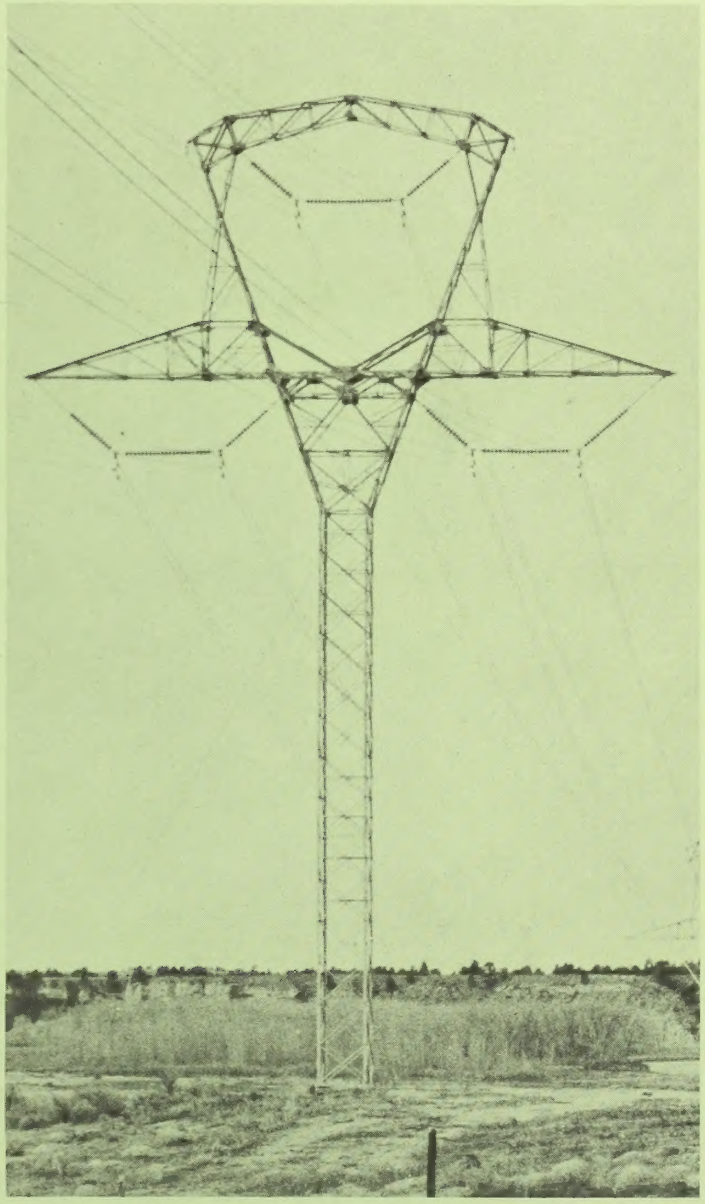
Federal Interagency
Colstrip Transmission Corridor Analysis



Prepared by an Interagency Study Team

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INTRODUCTION AND SUMMARY

INTRODUCTION AND SUMMARY

SCOPE OF TRANSMISSION ENVIRONMENTAL REPORT

The Colstrip Project comprises a power generating complex near Colstrip, Montana, and an associated power transmission system. Several utilities called Colstrip Project Management (CPM) have formulated plans to develop this generation and transmission. CPM is composed of utilities including the Montana Power Company, Puget Sound Power and Light Company, Portland General Electric Company, the Washington Water Power Company and Pacific Power and Light Company. This Colstrip Transmission Environmental Report (TER) has been developed to provide an environmental assessment of a system of transmission corridors and associated substations and communication facilities. This assessment will be the primary source document on transmission in the Federal Colstrip EIS being prepared by the Department of Interior. The basic transmission system proposed by CPM consists of two parallel 500-kV transmission lines to be constructed from Colstrip to Hot Springs, Montana, where they would tie in with the Bonneville Power Administration (BPA) 500-kV system (see Figure I-1, Vicinity Map). These lines would integrate power from Colstrip Units 3 and 4.

PROCEDURES AND ORGANIZATION

The Colstrip Federal EIS is multiagency in nature; therefore, it was decided that a cooperative effort would be beneficial in developing one document to cover all concerns. As the transmission analysis is unique to the EIS process, a Colstrip Transmission Work Management Plan was developed jointly by the U.S. Forest Service (USFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), and Bonneville Power Administration for preparation of the Colstrip Transmission Environmental Report (TER) and approved by an interagency Steering Committee. The Work Management Plan documented the basic assumptions, the overall study methodology, project management, organization and staffing requirements, estimates of project cost, and the project schedule. Agency letters of concurrence have been attached to the approved plan (Colstrip Transmission Work Management Plan, March 1977). A team of environmental specialists from the USFS, BLM and BPA was then assembled to complete the task with guidance and direction from the interagency Steering Committee (see Figure I-2).

The Study Team members assigned to this project and the support specialists providing input to the report are listed with their specialty and professional background, as follows:

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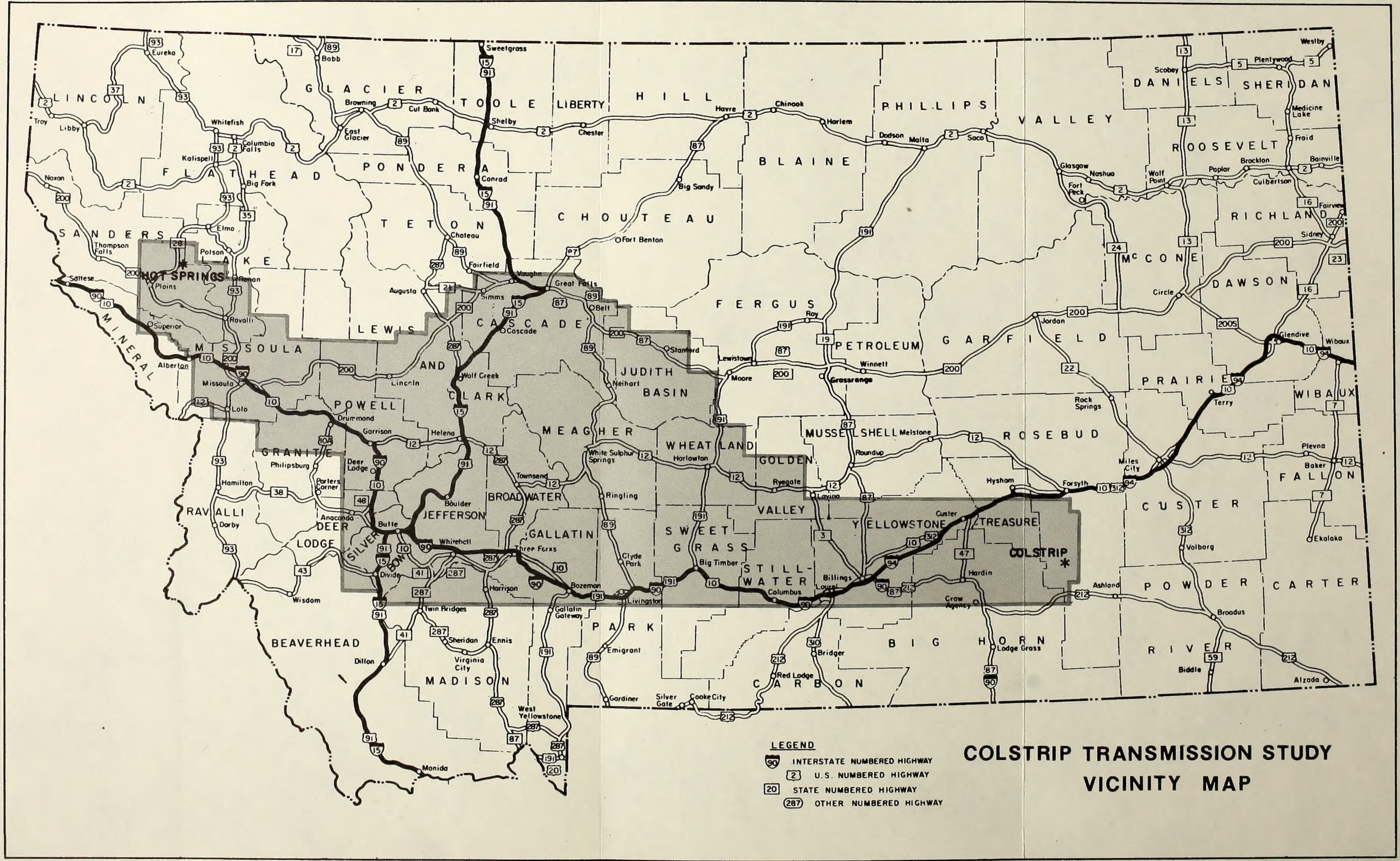
John C. Fisher (FS) B.S. in Forestry; 20 years of experience	- Forester
Gary O. Hathaway (BLM) B.L.A.; 16 years of experience	- Landscape Architect
Earl O. Skogley (Montana State University) B.S. in Soils; M.S. in Soil Fertility; Ph.D. in Soil Fertility and Plant Nutrition; 15 years of experience	- Agronomist
David J. Wester (FS) B.S. in Natural Resources - Soils; 9 years of experience	- Soil Scientist

SUPPORT SPECIALISTS

Mary Arneson (BPA) B.L.A.; 2 years experience	- Landscape Architect



COLSTRIP TRANSMISSION STUDY
VICINITY MAP

Figure I-1

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

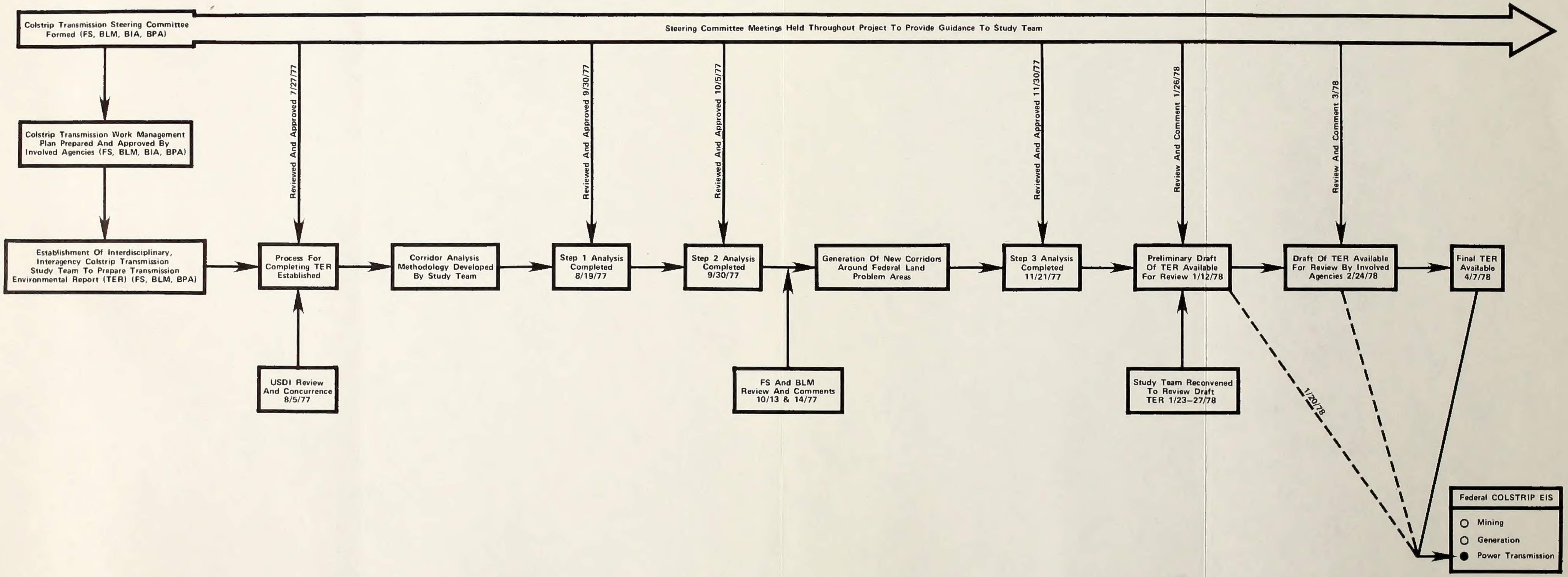

Colstrip Transmission Steering Committee Formed (FS, BLM, BIA, BPA)
Steering Committee Meetings Held Throughout Project To Provide Guidance To Study Team
Colstrip Transmission Work Management Plan Prepared And Approved By Involved Agencies (FS, BLM, BIA, BPA)
Establishment Of Interdisciplinary, Interagency Colstrip Transmission Study Team To Prepare Transmission Environmental Report (TER) (FS, BLM, BPA)
Reviewed And Approved 7/27/77
Process For Completing TER Established
USDI Review And Concurrence 8/5/77
Corridor Analysis Methodology Developed By Study Team
Reviewed And Approved 9/30/77
Step 1 Analysis Completed 8/19/77
Reviewed And Approved 10/5/77
Step 2 Analysis Completed 9/30/77
FS And BLM Review And Comments 10/13 & 14/77
Generation Of New Corridors Around Federal Land Problem Areas
Reviewed And Approved 11/30/77
Step 3 Analysis Completed 11/21/77
Review And Comment 1/26/78
Preliminary Draft Of TER Available For Review 1/12/78
Study Team Reconvened To Review Draft TER 1/23–27/78
1/20/78
Review And Comment 3/78
Draft Of TER Available For Review By Involved Agencies 2/24/78
Final TER Available 4/7/78
Federal COLSTRIP EIS
○ Mining
○ Generation
● Power Transmission

Figure I-2

Toni Blackburn-Elliot (BPA) - Environmental Specialist
B.A. in Economics; J.D.;
4 years experience

Walt Myers (BPA) - Electrical Engineer
B.S. in Electrical Engineering; P.E.;
15 years experience

Mike Newsom (BPA) - Geographer
B.S. in Geography

Dennis Porter (BPA) - Electrical Engineer
B.S. in Electrical Engineering; P.E.;
13 years experience

Gerry Reiner (BPA) - Electrical Engineer
B.S. in Mathematics; P.E.;
10 years experience

Steve Vickers (BPA) - Environmental Specialist
B.S. in Geology;
5 years experience

Frank Worth (BPA) - Civil Engineer
B.S. in Civil Engineering;
B.S. in Geology; P.E.;
6 years experience

Karen Delano (BPA/BLM) - Environmental Specialist
B.A. in Art;
1 year experience

PROCESS

The Colstrip Transmission Study Team developed the following 4-step process to complete the analysis and evaluation required for this project. This procedure was reviewed and approved by the Department of the Interior at the Washington, D.C. level (Wilkerson 8/17/77, see Appendix F):

Step 1 - Identify the Least Impact Corridors for Each Plan-of-Service

Develop plans-of-service for Helena, Great Falls and Butte-Anaconda by identifying corridor segments for each plan-of-service. Develop a procedure for segment environmental analysis and evaluation to eliminate the least desirable segments for each plan-of-service. The Applicant's proposed corridor will be retained for comparative analysis and evaluation. Prepare a report which will recommend the initial elimination of segments and document the rationale for dropping segments from further environmental analysis. Submit this report to the Steering Committee for their review and concurrence related to respective agency requirements.

Step 2 - Comparatively Analyze and Evaluate the Applicant's Proposed and the Alternative Corridors

A complete "NEPA-level" evaluation will be conducted for the least impact corridors identified for each plan-of-service in Step 1 (i.e., existing environment, impacts, mitigating measures, unavoidable impacts, etc.). Existing information will be utilized to the extent possible, however, critical resource data needed for proper analysis will have to be remapped. If determined necessary, a field review of critical areas may be required.

Step 3 - Identify and Evaluate Alternative Corridors Around Federal Land Problem Areas on the Applicant's Proposed Corridor Only

In areas of concern on Federal lands along the Applicant's proposed corridor, alternative corridor segments will be generated by the Study Team. These alternative segments will serve the same purposes electrically as the total length affected by the concerned portion of the proposed corridor. A complete "NEPA-level" evaluation of these alternative segments will be used to compare them with the Applicant's proposed corridor areas of concern.

Step 4 - Preparation of TER

The information and evaluation generated in the previous steps will be combined into the Colstrip Transmission Environmental Report. This report is intended to contain sufficient information for the land management agencies (i.e., BLM, BIA, USFS) to serve as an aid in the decision process for transmission permit applications.

OBJECTIVES

The objective of this report is to provide the environmental analysis of both the Applicant's proposed (state approved) corridor, and the alternate corridors presented by both CPM and the State of Montana in studies previously completed. In addition, new corridors were to be generated around problem areas on public lands. To perform this analysis, the interagency Study Team developed a methodology to assess comparatively the impacts from the proposed and alternative corridors. Every effort was made to avoid duplication of work completed in the previous studies. The final Transmission Environmental Report will be used as the principal source document in the Federal Colstrip EIS preparation and in addition will provide information required for the Federal Land Managers' decision process.

Before conducting the environmental analysis and evaluation, the Study Team developed a set of objectives for this impact analysis. They are as follows:

1. ECOLOGY

    1.1 Minimize disturbance to terrestrial wildlife (birds, animals of all types) and their habitats.

    1.2 Protect rare, threatened, and endangered species.

    1.3 Minimize damage to aquatic ecosystems (including plankton, other microorganisms, invertebrates, flora, fin fish, shell fish, amphibious fauna, birds and mammals which depend on wetlands and/or water bodies).

    1.4 Avoid wilderness and other classified areas.

1.5 Minimize disturbance of vegetation and vegetative cover.

2. OTHER FEATURES OF PHYSICAL ENVIRONMENT

2.1 Minimize impacts on water quality and yield.

2.2 Protect air quality.

2.3 Minimize soil erosion and compaction.

2.4 Minimize number and extent of new access roads required.

2.5 Minimize disturbance of exceptional natural features.

3. LAND USE

3.1 Minimize incompatibility with current, projected, and potential land use.

3.2 Minimize impact on existing and potential dispersed recreation areas.

3.3 Minimize impacts on existing and potential developed recreation sites.

3.4 Maximize multiple and shared use of right-of-way.

3.5 Minimize conflict with resource development (e.g., mining, agriculture).

3.6 Minimize interference with areas of cultural significance (e.g., Indian lands, historic sites, archaeological and paleontological sites).

3.7 Minimize impacts to legislatively and/or administratively sensitive areas.

4. VISUAL COMPATIBILITY

   4.1 Maximize visual compatibility.

   4.2 Minimize extent of unfavorable aesthetic impact.

5. STABILITY AND RELIABILITY OF THE LINE

   5.1 Minimize susceptibility to natural destructive forces.

   5.2 Minimize maintenance problems.

6. SOCIOECONOMIC

   6.1 Minimize displacement and relocation of residents.

   6.2 Minimize disruption of economic enterprises.

   6.3 Minimize impact to social services.

ASSUMPTIONS

This analysis and report followed the basic assumptions described in the Colstrip Transmission Work Management Plan (USDI 1977: Ch. 1), as agreed upon by all agencies involved. These assumptions relate to (1) content; (2) methodology/scope; (3) organization; (4) system planning; (5) location; (6) scheduling; (7) public involvement; and (8) financing. The methodology developed for impact analysis and the actual analysis of alternatives were based on conventional construction standards as presented in the Applicant's proposal section (see Ch. II). In the BPA-build alternative (Chapter II), standard BPA construction and maintenance criteria were assumed. Non-conventional construction techniques, special stipulations for reducing potential impacts, and other specific impact mitigating actions were considered separately, as presented in Chapter VIII.

REVIEW PROCEDURES AND SCHEDULE

The interagency Steering Committee has provided guidance to the Study Team throughout the project. One aspect of this support involved reviewing the scheduled progress and accomplishments of the Study Team. As each major step in the process was completed, it was reviewed and approved by the Steering Committee (see Figure I-2).

After the completion of Step 2, meetings were held with the involved land management agencies (11/13-14/77) to discuss the progress and results of the study at that time. The objectives of these review meetings were as follows:

1. Inform land managers about the Colstrip Transmission Environmental Report (TER);

2. Provide land managers an opportunity to identify general concerns for private and public lands along all corridors. Emphasis is to be placed on the identification of problem areas on Federal lands along the Applicant's proposed corridor; and

3. Provide land managers an opportunity to critique the corridor analysis and evaluation for weaknesses and data gaps.

SUMMARY

The Department of Interior determined that the Colstrip project proposal was of sufficient magnitude to require a Federal environmental impact statement prepared in accordance with the National Environmental Policy Act of 1969 (NEPA). To facilitate the preparation of this statement, an interdisciplinary Study Team was assembled to conduct the environmental analysis on the transmission portion of the Colstrip proposal. This analysis, or Colstrip Transmission Environmental Report (TER), will be the primary source document on transmission for the Federal Colstrip EIS.

The Study Team developed a four-step process to analyze and evaluate the transmission corridors. Step 1 consisted of identifying plans-of-service for Helena, Great Falls, and Butte-Anaconda from the corridor segments originated by the Applicant's consultant and the Montana Department of Natural Resources and Conservation. Upon evaluation, those segments that were considered to be the least desirable from an environmental standpoint were eliminated from further consideration. This resulted in identifying a single corridor of least environmental impact for each plan-of-service. The Applicant's proposed corridor and their proposed alternative around the Flathead Indian Reservation were retained for comparative analysis and evaluation.

In Step 2, a detailed environmental evaluation was made on each of the corridors identified in the results of Step 1. In addition to the analysis in Step 1, consideration was given to paralleling existing power lines and certain resource inventories were updated. The visual resource information used in Step 2 was not available for use in Step 1, and some of the available data for other resources were developed to a greater extent to show more clearly their relationship to potential impacts. Aerial survey and reconnaissance were also conducted in order to verify resource information.

During Step 3, additional alternative corridor segments were developed to avoid areas of concern identified by the Forest Service and Bureau of Land Management. These new segments were analyzed and evaluated to the same extent as were the corridors in Step 2.

Step 4 consisted of combining the information, analyses, and evaluations generated in the previous steps into the Colstrip Transmission Environmental Report. This includes: a description of the environment; a comparison of corridors; a description of impacts, mitigating measures, unavoidable adverse impacts; and identifying the short-term use and long-term productivity relationships and the irreversible and irretrievable commitments of resources.

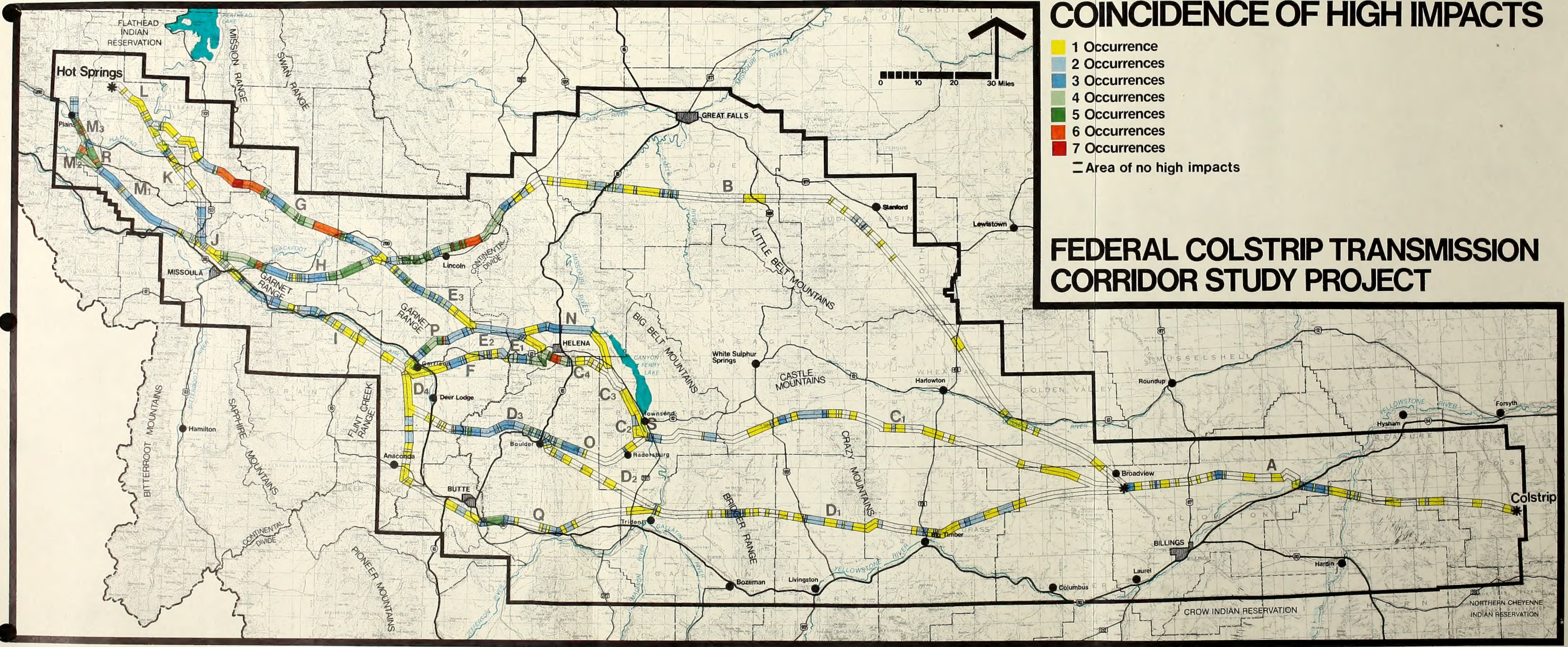
The corridors delineated in this study are two miles wide. Potential impacts on resource items located anywhere within the corridor were noted. Impact assessments were made based on a 300-foot wide reference route located within the two mile wide corridor to account for the fact that judicious centerline location and careful tower siting can reduce or eliminate some impacts. Assumptions upon which the analysis was based are listed in the Work Management Plan for this project; they also involve conventional construction techniques and standards as presented in the Applicant's proposal.

The overall objective of this procedure was to provide an environmental assessment of the Applicant's proposed and the alternative corridors. The environmental impacts were scored in order to compare one corridor with another in a manner that allows the reasons for the differences in scores to be easily ascertained.

The analysis reveals that the major differences in potential impacts among the various alternative corridors are due to differences in segment impact scores in the western portion of the study area (west of Townsend). Potential impacts are considerably greater in the mountainous portion of the study area as compared to those in the foothills and plains areas (see Figure I-3). This is reflected in the generally high per mile impact scores associated with the segments that pass primarily through mountains as compared to those located in more gentle topography (see column 20, Table VI-1 and Figure I-3).

The results of the Step 3 analysis indicate that the Trident-Boulder and Butte-Anaconda alternatives would result in the least impact on the existing environment. They are 9 and 8 percent lower, respectively, in total potential environmental impact than the Applicant's proposed corridor. These lower impact ratings reflect lower potential impact scores on the Vegetative Cover, Commercial Forest Land, Recreation, Prehistoric and Historic, Visual, and Unique Natural Resources determinants. There would also be less conflict with the Land Management Plans and greater benefits from paralleling existing powerlines along these two corridors.

The two Helena alternatives, with 5 percent lower impact scores and the Townsend-Boulder alternative with 6 percent lower scores than the



COINCIDENCE OF HIGH IMPACTS

- 🟨 1 Occurrence
- 🟦 2 Occurrences
- 🟦 3 Occurrences
- 🟩 4 Occurrences
- 🟩 5 Occurrences
- 🟧 6 Occurrences
- 🟥 7 Occurrences
- ⊐ Area of no high impacts

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure I-3

Applicant's proposed corridor, have the next least environmental impact potential. Their lower overall ratings reflect lower impact scores for the Vegetative Cover, Agricultural Land, Commercial Forest Land, Recreation, and Visual Resources determinants. The Helena alternatives have lower scores for the Fish and Wildlife determinant, whereas the Townsend-Boulder alternative has a lower score for the Range determinant. The paralleling advantage is also greater for these three corridors than for the Applicant's proposed corridor.

There is essentially no environmental siting advantage for the Great Falls alternative over the Applicant's proposed, as there is only a two percent difference in their total impact potential scores. The Great Falls alternative does have lower impact potentials for the Land Suitability, Surface Water, Recreation, Prehistoric and Historic, and Visual Resources determinants. There would be more advantage in paralleling along the Great Falls alternative than along the Applicant's proposed corridor. The Siegel Pass alternative would have higher impact potentials for all of the determinants and a lower paralleling advantage than the Applicant's proposal.

Figure I-3 depicts the study area, the corridor segments analyzed in Steps 2 and 3, and the coincidence of high impacts. Only high impact potential areas are shown, in keeping with the focus of this analysis.

DESCRIPTION OF THE PROPOSED ACTION

DESCRIPTION OF THE PROPOSED ACTION

BACKGROUND ON COLSTRIP TRANSMISSION PROJECT

APPLICANT'S PROPOSAL

Westinghouse Report

The utilities participating in the Colstrip Project have forecast power needs and have formulated plans to develop the generation and transmission required to meet these needs. In 1971, to evaluate the environmental impacts of the project, the Applicant began initial studies of important environmental constraints. In 1973, Westinghouse Environmental Systems Department was engaged by the Applicant to conduct a comprehensive environmental analysis of the project and compile the "Colstrip Generation and Transmission Project, Applicant Environmental Analysis" now referred to as the Westinghouse Report (WESD/AEA 1973). This report is a source document designed to provide data necessary for consideration of environmental effects to the state and Federal reviewing agencies. The Study included alternative corridor locations and conclusions relevant to the proposed action. The Westinghouse Report and the information developed for their report was reviewed by the Study Team and some of the data was used in completing the Colstrip Transmission Environmental Report.

Alternatives Considered

A transmission corridor, as presented in the Westinghouse Report, defined a belt 3 miles wide with actual centerline and tower location to be selected later. The transmission line alternatives discussed in this report include those suggested by Charles T. Main, Inc.; Westinghouse Environmental System Department; and Theodore Wirth Associates, Environmental Planning Consultants. The report indicated that 54 alternative corridors were possible from the 24 segments generated; overall length

Bureau of Land Management
Library
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varied from 417 miles to 478 miles (see Figure IV-1). The approach used in this analysis was to eliminate less desirable segments serving the same purpose, with the final alternative being the Applicant's recommended alternative corridor.

Public Involvement

In the spring of 1973, a public opinion survey was conducted by the Applicant to measure and understand public sentiment on the issues related to the Colstrip generating plants. There is no documentation in the Westinghouse Report (WESD/AEA 1973: Section 2.8.5) that this survey addressed the transmission facilities related to this project.

Colstrip to Broadview 230-kV Line

The Applicant's proposed corridor parallels an existing double circuit 230-kV power line from Colstrip to Broadview (approximately 110 miles long) now energized and carrying a part of the power generated from Colstrip Units 1 and 2. This line is designed so that it can be converted to a single circuit 500-kV as a portion of one of the Colstrip to Hot Springs lines (see "Description of Proposed Transmission Facilities," this chapter).

MONTANA DNRC'S INVOLVEMENT

In the course of the project, major changes in state laws and regulations were enacted. The Montana Major Facility Siting Act of 1973 requires the Montana State's Department of Natural Resources and Conservation (DNRC) to make certain findings and decisions concerning proposed facilities. Many aspects of the Colstrip Project, including transmission, are subject to this act. Therefore, an application was filed with the DNRC.

State's EIS

The State of Montana Draft EIS, dated November 1974, was the result of a study conducted by the Energy Planning Division of the DNRC to evaluate the proposed facilities. The primary objective of this EIS was to provide the data upon which the DNRC would base recommendations concerning the project to the Board of Natural Resources and Conservation (BNRC), which has the authority to make final decisions on projects. This objective would, therefore, be required in the state decision-making process. A second objective of the study was to document probable impacts of the project in order to fulfill the requirements of the Montana Environmental Policy Act.

The final State of Montana EIS, dated January 1975, included recommendations to the Board of Natural Resources and Conservation that the application on the project be denied.

Alternatives Considered

The State of Montana EIS includes the alternatives considered in the Westinghouse Report plus other alternatives related to plans-of-service not previously addressed (see Figure IV-1). No detailed analysis of the environmental impacts on the various alternative corridors was completed by the state for comparison or rating. All information on transmission presented in the State EIS is documented in Volume One, Volume Four, and the Summary (DNRC/DEIS 1974).

Public Involvement

The DNRC EIS process involved the public on two levels:

1. Questionnaire - In August 1974, a general energy development questionnaire was randomly distributed to 2,200 Montana State residents (DNRC/DEIS 1974: Vol. 4: 214). Transmission line comments approved the use of existing transmission corridors; disapproved of new transmission lines; and favored a fee to be paid to land owners if new transmission lines must be built on their property.

2. DEIS Comments and Public Meetings - The published draft environmental statement was made available for public comments. A series of

19 public meetings were conducted in selected communities throughout Montana between November 25, 1974 and January 9, 1975. Summaries of these public meetings are provided in the Final State of Montana Colstrip EIS (DNRC/FEIS 1975: Section III). Nearly 600 letters were received from individuals commenting on information provided in the draft EIS. In addition, various organizations submitted position statements, comments were received, and telephone comments and petitions were submitted. A summary of these comments is also provided in the Final EIS (DNRC/FEIS 1975: Section III).

Siting Hearings

Public hearings by the Montana Board of Natural Resources and Conservation commenced in Helena, Montana, on May 20, 1975, and were temporarily adjourned on June 4, 1975, to start hearings by the Montana Board of Health and Environmental Science. Health hearings commenced on June 5, 1975, and testimony ended on September 16, 1975. The Board of Natural Resources and Conservation hearings then resumed on January 19, 1976, and were concluded on March 30, 1976. The verbatim transcripts of these hearings is approximately 17,000 pages. In addition, approximately 1,400 exhibits were introduced. The hearing process, including closing arguments, was completed in June 1976.

BNRC's Approval of Applicant's Proposal

At a scheduled and noticed meeting on June 24, 1976, the Montana Board of Natural Resources and Conservation (BNRC) approved the application to construct Colstrip Units 3 and 4 and associated facilities and granted the applicant a Certificate of Environmental Compatibility and Public Need, subject to certain stated conditions. These conditions are set forth in the Board of Natural Resources and Conservation Findings of Fact, Opinion, Decision, Order and Recommendations dated and signed on July 22, 1976.

DNRC's Centerline Studies

Approval of the Colstrip Project included the decision that the final centerline location of the right-of-way of the transmission line be subjected to future approval of the Board of Natural Resources and Conservation with a specific approval process to be worked out with the Board. This specific approval process was in the form of a contract between the Colstrip Applicant and the Montana Department of Natural Resources and Conservation dated August 2, 1977, which specifies that the DNRC will evaluate the transmission centerline and assist the Board with its approval responsibilities. The Board is to ensure that the final centerline location, and all aspects of the line construction, will result in minimal environmental impact.

Work is now underway on this contract. The centerline is being revised and approved by segments westward from Colstrip. The Applicants and DNRC have been informed that there is a risk in completing this work before the Federal land management decisions are made (R. Wilkerson to J. Evans, August 12, 1977; see Appendix F).

FLATHEAD INDIAN RESERVATION

The western terminal for all alternatives, except the Siegel Pass alternative which would require a new substation near Plains, Montana, is the Bonneville Power Administration substation located near Hot Springs, Montana, on the Flathead Indian Reservation (See Fig. III-1). The Flathead Reservation consists of 617,553 acres in northwestern Montana in Sanders, Lake and Missoula Counties.

Although the Administration of Reservation Lands is unique, impacts were analyzed regardless of the ownership of the lands upon which whey would occur. The alternative developed through the Siegel Pass area with a new substation near Plains was proposed as an alternative by the Applicant in previous studies. It was analyzed, therefore, to provide a comparative assessment of impacts.

As tribal lands would be impacted by this project, the team provided the Confederated Salish and Kootenai Tribal Councils the opportunity to review the environmental analysis process prior to completion of the report. The letter offering the tribal council this opportunity was not acknowledged (Wilkerson to Mitchel, September 7, 1977; see Appendix F).

The team also requested data for discussion of potential social and economic impacts to the tribe through the Bureau of Indian Affairs (BIA) (Pyrch to Pennington, September 26, 1977; see Appendix F). On December 15, 1977, correspondence received from the BIA indicated that the information will not be made available (Office of the Area Director to Pyrch, December 15, 1977; see Appendix F).

FEDERAL GOVERNMENT'S INVOLVEMENT

History

In March of 1973 it was determined by the Department of Interior that the Colstrip Project was of sufficient magnitude that a comprehensive EIS was needed to satisfy the requirements of the Federal Government.

The Council on Environmental Quality published guidelines for the preparation of environmental impact statements provide for the designation of a "lead agency" where several agency actions are involved. As it is clear that the Colstrip Project is multi-agency in nature from a Federal standpoint, the "lead agency" to assume the supervisory responsibility for preparation of the Federal EIS was assigned by memo to the Bureau of Land Management (BLM) on February 22, 1974 (Lyons to BLM Director, February 22, 1974; see Appendix F). An EIS team of personnel from within the BLM was established, with headquarters in Billings Montana. Due to problems in the coordination effort with the State of Montana environmental assessment, the BLM team was released in the fall of 1974 with the intent of regrouping in the spring of 1975 after the final state EIS was released and state decisions were made on corridor selection.

On November 15, 1976, the Department of Interior transferred the lead agency responsibility for preparation of the Colstrip Environmental Statement to Bonneville Power Administration (BPA). This memo (see Appendix F) noted that other involved Interior Bureaus were expected to be represented on the Colstrip EIS team. The continued cooperation and participation of the U.S. Forest Service (USFS) was requested.

The BPA Division of Engineering and Construction was assigned the lead responsibility of preparing the transmission line analysis for the Federal EIS. A Work Management Plan was written for this phase of the project and signed off by the land management agencies involved (BLM, BIA and USFS) and BPA. The Work Management Plan set up an interagency, interdisciplinary Study Team to establish an analysis methodology and complete the analysis and an Interagency Steering Committee to direct the process. The Colstrip Transmission Environmental Report (TER) is the result of this analysis.

Federal Actions Required on Applicant's Proposal

Federal agencies must comply with the following legislation when proposed actions will significantly affect the environment or when proposed actions will affect land use:

River and Harbor Act of 1899
National Historic Preservation Act of 1966
National Environmental Policy Act of 1969 (NEPA)
Federal Clean Air Act
Federal Water Pollution Control Act
National Trails System Act
National Wilderness Preservation Act of 1964
Intergovernmental Cooperation Act of 1968
Wild and Scenic Rivers Act of 1968
Endangered Species Act of 1973
Federal Land Management and Policy Act of 1976

In addition to complying with these acts, several agencies have permit requirements or other responsibilities that must be fulfilled.

Geological Survey. The Geological Survey Area Mining Supervisor is responsible for approving plans for mining Federal coal. Western Energy Company has filed permit applications for mining coal to supply the proposed Colstrip Project.

Bureau of Land Management. BLM currently has pending coal lease applications. Additionally, future coal-lease offerings may be made.

Transmission right-of-way easements would be required across lands managed by BLM for the proposed Project.

Forest Service. The Forest Service has received applications for transmission line right-of-way easements crossing the Lewis & Clark, Helena, and Lolo National Forests.

Rural Electrification Administration. The REA anticipated that Upper Missouri G & T Electric Cooperative, Inc., and Central Montana Electric G & T Cooperative will apply for Federally-guaranteed loan funds to finance their contemplated 7% ownership participation in the Colstrip Project.

Environmental Protection Agency. The EPA may be asked to issue a Permit of Significant Deterioration (PSD), depending upon the result of current litigation over whether the Project is subject to those provisions. If so, EPA will complete a PSD Review independently, which, depending upon its availability, may be summarized in the EIS.

Bureau of Indian Affairs. The Superintendent may grant rights-of-way across Indian lands after permission has been granted by the Tribal Council and by the individual Indian landowners.

U.S. Corps of Engineers. Although not contingent upon completion of the Colstrip EIS, Corps of Engineers permits would be required for the transmission lines crossing the Yellowstone and Missouri Rivers, and for any fords or culverts in streams flowing 5 cubic feet per second or more.

Bureau of Reclamation - is responsible for reviewing applications for rights-of-way to determine that the planned construction would not conflict with the Federal power marketing and transmission program. The Bureau serves in an advisory capacity.

Bonneville Power Administration - has authority for the sale, delivery, and exchange of electric energy in the Pacific Northwest (Oregon, Washington, Montana west of the Continental Divide, and portions of Nevada, Utah, and Wyoming within the Columbia River drainage). The Applicant's proposed 500-kV lines would interconnect with the BPA transmission system at Hot Springs, Montana.

Applicant's Request for a BPA-Build Alternative

On September 26, 1977, the Montana Power Company, acting on behalf of all the Applicants, requested that BPA construct adequate 500-kV transmission lines from the BPA transmission system to a point within the Applicant's proposed corridor in the Helena-Ovando area (McElwain to Hodel, September 26, 1977; see Appendix F).

On December 2, 1977, BPA answered the request and agreed to request Congressional authorization for the construction of necessary transmission and substation facilities, subject to several conditions, before expending significant funds (Hodel to McElwain, December 2, 1977; see Appendix F).

The TER considers this option as a BPA-Build alternative to the proposed action.

ELECTRICAL SYSTEM CONSIDERATIONS

Background information for this section can be obtained from Miller (1970), Stevenson (1962), Kimbark (1948-56), and Byerly and Kimbark (1974).

ELECTRICAL SYSTEM REQUIREMENTS

Colstrip generator Units 1 and 2, now in operation, were a joint development of the Montana Power Company (MPC) and the Puget Sound Power and Light Company (PSP&L). Each unit is rated at 360 MW, the output of one unit going to each of the companies.

Another joint development of generation at Colstrip, Units 3 and 4, is presently planned. The participants in this project and their share of the project power are MPC - 30%, PSP&L - 25%, Portland General Electric Company (PGE) - 20%, Washington Water Power Company (WWP) -]5%, and Pacific Power and Light Company (PP&L) - 10%. These companies (Applicant), as a condition of being granted a permit by the Montana Board of Natural Resources and Conservation, have offered a 10% share in the project to the Central Montana Electrical Generation and Transmission Cooperative, Inc. and to the Upper Missouri Electrical Generation and Transmission Cooperative, Inc. Units 3 and 4 are presently scheduled for commercial operation in April 1982 and February 1983, respectively.

Colstrip Units 3 and 4 are needed to supply power to the growing electrical loads in the areas served by the Applicant. The MPC needs could be met by units smaller than the proposed 780 MW (700 MW net output) units. However, larger units provide power at higher efficiency than smaller units, thereby conserving energy and lowering costs. MPC has therefore planned construction of the 780 MW units with participation by the other Applicants.

MPC would deliver the other Applicant's share of Colstrip power (1310 MW total from Units 1-4) to the Bonneville Power Administration (BPA) transmission system. BPA would in turn deliver the power to the Applicant's systems where they interconnect with the BPA system. The BPA and MPC systems are presently interconnected at BPA's Hot Springs and Anaconda Substations and MPC's Kerr Substation, all in Montana (see Figure III-20).

The existing MPC transmission system does not have sufficient capacity to deliver 1310 MW to the BPA system. Additional circuits would be needed between Colstrip and the BPA system. At least two new circuits would be needed for reliable service. If only one new circuit were added and an outage of this circuit occurred, the existing system would overload. To eliminate the overloads, it would be necessary to reduce delivery of Colstrip Power to the BPA system.

In addition to providing sufficient power carrying capacity to prevent overloads on the transmission system between Colstrip and the BPA system, the new lines along the existing system must also provide a strong enough electrical tie between the Colstrip generators and the BPA system. Under normal conditions the generators in an interconnected electrical system all rotate in step with each other. If the tie is too weak, minor disturbances or load changes on the system could cause the Colstrip generators to rotate out of synchronism with other generators on the BPA transmission system or other systems. If synchronism is lost, either the generators are automatically disconnected from the transmission system or interconnecting lines automatically open between the areas of the power system with out of step generators. Such a system would be unstable. Under unstable conditions some areas may be left with a deficiency of generation which would make load dropping necessary in those areas.

Oscillations in the speed of the generators may not be severe enough to cause loss of synchronism but may still cause voltages on the system to temporarily drop low enough to cause loss of load. The electrical tie to the generators must also be strong enough to prevent such excessive voltage oscillations.

If only one line were provided for Colstrip integration, loss of that line due to a fault of accidental opening would cause the 230-kV connections between eastern and western Montana to open. This would result in a generation deficiency and loss of load in western Montana. A fault on a 500-kV line from BPA's Hot Springs, Montana substation to the west would cause a separation of the power system between Hot Springs and Spokane, Washington. This separation would interrupt transfer of Colstrip power to the participants outside of Montana. A system this weak would not meet the Reliability Criteria for System Design of the Western Systems Coordinating Council (WSCC), of which all of the Colstrip participants are members.

The new lines must also provide the transmission capacity needed to supply power to the increasing loads in the major load areas on the MPC system. Substations would be needed in these areas to provide connections from the Colstrip transmission lines to the local transmission systems. The Billings, Butte-Anaconda, and Missoula areas have large concentrations of load and would need reinforcement at about the time that Colstrip Units 3 and 4 go on line. The Great Falls area also has a large concentration of load but has about 200 MW of hydro generation. This area should not need additional transmission support until well into the 1990s.

OPTIONS FOR MEETING ELECTRICAL SYSTEM REQUIREMENTS

Direct Current (dc) or Alternating Current (ac) Transmission

Both dc and ac transmission systems are technically feasible for the new Colstrip circuits. The choice of ac or dc is primarily dependent on their relative costs. Line construction costs are lower for a dc line than for an ac line of equivalent capacity. However, terminal costs for the dc line are higher. Therefore, dc transmission compares more favorably to ac transmission as line length increases. A single bi-polar dc line has a line reliability about equivalent to a double circuit ac line.

Recent cost data show that a dc line including terminal equipment that would provide a system as stable as two 500-kV ac lines for integration of Colstrip Units 3 and 4 would cost about 50% more than the ac lines. This analysis was based on a 430-mile, ± 400-kV dc line from Colstrip to BPA's Hot Springs Substation. Because of its cost, dc transmission would not be feasible for integrating Colstrip units 3 and 4 under this proposal.

Voltage Level and Number of Lines

The capability of an ac transmission line to transfer power is proportional to the square of the voltage level of the line. Two nominal 500-kV lines would provide sufficient transfer capability between Colstrip and the BPA system for integration of Colstrip units 3 and 4. At 345-kV and lower voltages, more lines would be needed. At 345-kV, four lines would be needed. At 230-kV about 10 lines would be needed. The increased right-of-way and increased transmission system losses associated with the lower voltage systems make them both uneconomical and environmentally unacceptable. At voltages above 500-kV, no reduction in the number of required lines would occur because a minimum of two lines would be required for reliability. Increasing the voltage to 765-kV, the next standard increment above 500-kV, would provide excess capacity and would decrease system losses. But, the cost of providing this excess capacity would be prohibitively high. BPA economic studies have shown that line loadings would have to be substantially higher than those planned on the Colstrip lines to justify 765-kV construction.

A nominal voltage of 500-kV would provide the lowest cost and least environmental impact for the Colstrip transmission lines. Two 500-kV lines would be needed for reliability.

Overhead or Underground Transmission

An underground 500-kV ac, compressed gas, transmission cable would cost about 16 times as much per mile as an overhead line of the same capacity through flat terrain, based on 1977 BPA cost estimates. High pressure oil cable would cost about 10 times as much as overhead line and would require shunt reactive compensation stations every 25 to 50 miles.

Costs of underground would be higher through mountainous terrain. Because of its high cost, underground transmission would not be feasible for integrating Colstrip Units 3 and 4.

Double-Circuit or Two Parallel Single-Circuit Transmission Lines

Comparison of Performance

BPA operating records and calculations show that outages of one circuit of a double-circuit line will occur about as often as outages of a single-circuit line. However, simultaneous outages of both circuits of double-circuit lines will occur more often than simultaneous outages of two parallel single-circuit lines on the same right-of-way.

Simultaneous outages for both double circuit and two single circuits have been shown by experience to be primarily caused by lightning. In the case of BPA's 500-kV double circuit lines equipped with overhead ground wire(s), the simultaneous outages are mostly the result of back-flashes where lightning strikes the overhead ground wire or structure, raising the tower potential. When such potential exceeds the line insulation level, outages on one or both circuits can occur. In the case of two 500-kV single circuits, the simultaneous outage results from lightning strikes to the overhead ground wires of both circuits simultaneously. These faults usually involve only one phase of the transmission line and cause momentary outages of less than one second.

The experience of simultaneous outages of Extra High Voltage (EHV) double circuit lines above 345-kV is very limited due to their recent introduction into power system networks. In contrast, data on simultaneous single circuit outages are available due to the number of EHV lines and years of operation on power system networks. In the case of the simultaneous outages on double circuit lines, BPA's experiences with 115 - 345-kV lines indicate that approximately 35% of all lightning trip-outs are simultaneous outages. Experiences by other utilities show a general range of 25%-50%. Experience also indicates that the ratio of simultaneous outages for double circuit lines vs. two single circuit lines of the same voltage is approximately 5 to 1. Various empirical and experimental methods are available to estimate total lightning outages on transmission lines. BPA uses the electro-geometrical method in estimating total lightning trip-outs.

To determine whether to use double circuit or single cirucit construction, it is necessary to determine the consequences of simultaneous outages and how often simultaneous outages related to line design would occur for each type.

Consequences of Simultaneous Outages of Both Circuits

Two switching stations are planned between Colstrip and the BPA 500-kV system at Hot Springs, one in the Billings area (Broadview) and one in the Helena Area. Simultaneous loss of both circuits between Colstrip and Broadview would cause all four Colstrip generators to disconnect from the system. Loss of both circuits between Broadview and Helena would cause Colstrip Units 3 and 4 and one of the smaller units to disconnect. Momentary loss of both Helena-Hot Springs lines would cause one of the smaller units to disconnect.

Frequency of Simultaneous Outages of Both Circuits

Based on the electro-geometrical method and experience with the lower voltage system, BPA has estimated the frequency of simultaneous outages for the Applicant's proposed line design, which is two single-circuit lines on the same right-of-way, and for the various other designs considered feasible.

Simultaneous outages of the Applicant's proposed design would be likely to occur about once in 27 years per 100 miles of line compared to about once in five years for a double-circuit design using the same conductor clearances (138 inch). For designs using reduced (100 inch) clearances, simultaneous outages could be expected about once in 8 years for the two single-circuit design, and about once in 1-1/3 years for the double-circuit design, per 100 miles of line.

Methods of Mitigating the Effects of Loss of Both Circuits

Installation of a 350 MW braking resistor at Colstrip would eliminate the need for an equivalent amount of generator dropping, eliminate the need for any generator dropping for momentary loss of both Helena-Hot Springs lines, and reduce the amount of generator dropping for momentary loss of both Broadview-Helena lines.

Installation of single pole switching on the Broadview-Helena or Helena-Hot Springs lines would eliminate the need for any generator dropping for momentary loss of both circuits in either of these sections. Single pole switching on the Colstrip-Broadview generator dropping for momentary loss of both of these circuits.

Upgrading Existing Facilities

The existing facilities in Montana are inadequate for integration of Colstrip Units 3 and 4. In order to upgrade these facilities to the level required for Colstrip integration, it would be necessary to increase conductor sizes and raise voltage levels on the lines and terminal equipment. Transformers would be needed to connect the higher voltage lines to the lower voltage system.

The existing transmission line towers would not be strong enough to support the larger conductors needed nor would they provide adequate clearances for the increased voltage levels. It would be necessary to rebuild a major portion of the existing system. Wider corridors would be required. Space for the wider corridors would probably not be available in many locations which would require rerouting lines and acquiring new right-of-way.

The cost of necessary rebuilding would probably equal or exceed the cost of constructing the proposed plan. Rebuilding would require lengthy outages during construction. During these outages the system would be too weak to transmit Colstrip power reliably and to serve Montana loads. It would not be feasible to upgrade the existing transmission system to integrate Colstrip Units 3 and 4.

FEASIBLE ELECTRICAL PLANS-OF-SERVICE

The development of feasible alternative corridors was based primarily on aspects of route selection which affect the electrical performance of the power system and those that affect the cost of the plan-of-service (see Figures IV-2 and IV-3). These factors are total length of the line, length of the line segments between switching stations or substations, and the location and number of such stations developed. Some corridors were not considered due both to obvious natural barriers, such as impassible mountains, and to wilderness areas. However, environmental considerations were, essentially, not included in this part of the corridor evaluation. Basic feasible corridors were defined by their points of connection, such as the Colstrip-Broadview-Helena-Hot Springs Corridor. The many possible variations in the specific route that might be selected for a line connecting two points were not considered significant unless they caused the total line length to vary more than approximately 10%.

One line, designed for 500-kV operation, has already been built between Colstrip and Broadview. This line is now being operated at 230-kV with the conductors connected to provide two circuits. These two circuits are connected between the Colstrip 230-kV bus and the Broadview 230-kV bus. The Broadview Substation provides a 230-kV tie from Colstrip to the Billings and Great Falls areas for integration of Colstrip Units 1 and 2. The Applicant plans to convert the two Colstrip-Broadview 230-kV circuits to a single 500-kV circuit in 1982 for integration of Colstrip 3. This line would be one segment of the Applicant's proposal for two 500-kV lines from Colstrip to Hot Springs.

In developing feasible electrical plans of service for Colstrip transmission, no alternatives to the proposed plan for the line segments between Colstrip and Broadview were considered. Since the Broadview substation has already been partially developed, is close to Billings, and will provide adequate support to Billings area loads, no other 500-kV substation development will be considered in this area.

The major variations among the feasible transmission plans occur between Broadview and the point of interconnection with the BPA system. The lines could be routed from Broadview to the interconnection via right-of-way which passes near the load concentration at Great Falls, Helena, or Anaconda.

If the point of interconnection is east of Hot Springs on BPA's 230-kV system, BPA would have to build a 500-kV tie from the point of interconnection to the BPA 500-kV grid.

The transmission lines and tower designs proposed by the Applicant, the construction procedures to be used, the operation and maintenance characteristics of the lines, and the cost estimates for the lines are discussed under "Description of the Proposed Transmission Facilities" in this chapter.

Applicant's Proposed Plan-of-Service

The Applicant has proposed building two 500-kV lines from Colstrip to BPA's Hot Springs Substation routed via Broadview and Helena on new right-of-way. Each line would be built on its own towers, but both lines would be on the same right-of-way. Major load areas would be served by step down transformers in substations at Broadview and Helena. Developing loads in the Anaconda and Great Falls areas could be served, when necessary, by transmission additions or reinforcement out of Helena. One line between Colstrip and Broadview has already been built and is now operating as two 230-kV lines for integration of Colstrip Units 1 and 2.

The proposed plan-of-service, at 431 miles (862 circuit miles), is the shortest of the feasible corridors to Hot Springs. About 35% series compensation is needed in the lines to strengthen the tie between Colstrip and Hot Springs to provide a sufficiently stable system. If a 350 MW braking resistor were installed at Colstrip, compensation could be reduced to about 25%. The other feasible corridors, being longer, would require about an additional 5% series compensation.

This plan, since it requires the least series compensation, would be least susceptible to subsynchronous resonance (SSR) problems. SSR occurs when the electrical network with the series compensated lines interacts with the generators to reinforce the tendency of the machines to oscillate at certain resonant frequencies below 60Hz, the synchronous frequency of the power system. If the machines oscillate at a subsynchronous resonant frequency, the machine shafts may be damaged. The interaction between the electrical and mechanical systems is a function of the resonant frequencies of the electrical network which in turn are a function of the amount of series compensation. Studies show that SSR problems are more likely to occur as series compensation is increased.

The proposed plan would cost less than the other alternative primarily because it would be shorter and would require less series compensation. The amount of substation development would be about the same in all of the basic alternative plans. A more detailed discussion of cost comparisons follows in the discussions of the alternative plans. A minor part of the costs of this plan have already been expended (surveying, costs related to right-of-way procurement). These costs would still remain for the other plans.

Anaconda Area Alternative

This plan consists of two 500-kV lines between Colstrip and Hot Springs routed via Broadview and the Anaconda area. Major area loads would be served by step-down transformers in substations at Broadview and near Anaconda. Developing loads in the Helena and Great Falls areas could be served by transmission additions or reinforcement out of the Anaconda area substation or by generator additions in the Great Falls area. One line between Colstrip and Broadview has already been built and is now operating as two 230-kV lines.

The lines in this plan could vary in length from about 445 to 470 miles depending on the choice of route. The longer line would involve routing from Broadview through the Bozeman area to Anaconda and on to BPA's Hot Springs Substation. The shorter line would involve routing from Broadview through the Trident area to the Garrison area and on to Hot Springs. 500-kV switching would be provided and the Anaconda area would be supported in the latter plan by building a 500/230-kV substation near Garrison, about 25 miles north of Anaconda, and close to MPC's Anaconda-Ovando and BPA's Anaconda-Hot Springs lines. Both lines would be looped into the Garrison Substation.

Although the 500/230-kV transformer at Garrison would not be needed to support the Anaconda area until the mid or late 1980's, its installation and the loop-in of the two 230-kV Anaconda lines would be justified as soon as the Garrison station is energized. With the transformer in service, system losses are reduced about 40 MW during peak load periods. Also, this transformer would drop off enough power in the Anaconda area to make it possible to defer construction of the Garrison-Hot Springs 500-kV lines until Colstrip Unit 4 goes on line.

Great Falls Area Alternative

This plan consists of two 500-kV lines between Colstrip and Hot Springs routed via Broadview and Great Falls. Major area loads would be served by step-down transformers in substations at Broadview and in the Great Falls area. Developing loads in the Anaconda and Helena areas could be served by transmission additions or reinforcement out of Great Falls or by generator additions in the Anaconda area. One line between Colstrip and Broadview has already been built and is now operating as two 230-kV lines.

The lines in this plan could vary in length from about 450 to 460 miles depending on the choice of route. The longer line would involve routing from Broadview to Great Falls to Ovando paralleling the existing 230-kV line and on to Hot Springs from Ovando. The shorter line would involve routing a line about 20 miles south of Great Falls on an east-west line connecting the Billings-Great Falls and Great Falls-Ovando 230-kV lines, with the remainder of the line the same as the longer line. In the latter plan, 500-kV switching would be provided and the Great Falls area would be supported by building a 500/230-kV substation about 40 miles southwest of Great Falls where the 500-kV lines would intersect the Great Falls-Ovando line. The 500/230-kV transformer would not be needed for Great Falls support until the 1990's, however, it would be needed if 230-kV support to the Anaconda area were to be provided from this station. The 230-kV transmission additions or reinforcement between the Great Falls and Anaconda areas would be needed much earlier in this plan than in the proposed plan or in the Anaconda alternative unless generation were added in the Anaconda area.

Transmission line costs for the shorter and longer versions of this plan would be about 3% and 6% higher, respectively, than the proposed plan. Both variations would require an additional 5% series compensation over the proposed plan. The additional 5% compensation would cost less than 1% of the total line cost and would not be expected to cause a subsynchronous resonance (SSR) problem.

APPLICANT'S/BPA INTERCONNECTION POINTS OTHER THAN HOT SPRINGS

In the proposed plan, the Applicant would construct the 500-kV transmission lines needed to connect Colstrip to the nearest BPA 500-kV substation, which is Hot Springs. However, there are other feasible points of interconnection.

The BPA service area extends east of Hot Springs as far as the Continental Divide (about to Helena). The Applicant could build as far west as the Helena area, or to a point between Helena area and Hot Springs, and BPA could build the 500-kV lines needed to complete the connection to the BPA 500-kV grid. The point of the interconnection would not have to be a substation. The BPA and Applicant's lines could be connected at a transmission line tower. Any of the Colstrip-Hot Springs plans discussed previously could be built by the Applicant to a point between the eastern boundary of the BPA service area and Hot Springs, with BPA building from that point to Hot Springs, without changing the electrical performance of the plan.

It is BPA policy to use double-circuit construction as much as possible to minimize right-of-way requirements. Any lines built by BPA in the Hot Springs area would probably be double circuit.

There is enough room on the BPA Hot Springs-Anaconda 230-kV right-of-way, except for a short section near Missoula, to build a double-circuit 500-kV line in addition to the 230-kV line. BPA would make use of this right-of-way, if possible, in any plan to build from Colstrip to Hot Springs. The right-of-way from Hot Springs to the Garrison area could be used if a 500-kV substation were developed in the Garrison or Helena areas.

If access to Hot Springs is restricted, making it necessary to connect the Colstrip lines to some other point on the BPA 500-kV grid, a 500-kV substation could be developed near, and connected to, the Hot Springs-Dworshak line. If the Colstrip lines were routed near Missoula, south of the Flathead Reservation, the station could be built in the vicinity of Plains, Montana. About five to fifteen miles of additional line per circuit from Colstip would be needed, depending on the route chosen for the Colstip lines. The electrical performance of a system terminated at Plains would be essentially the same as that of one terminated at Hot Springs.

There is a possibility of future development of coal-fired generation near the coal fields in eastern Montana and western Wyoming. The power from some of these plants may be scheduled for transmission to coastal areas in the Pacific Northwest. The distance from these plants to the coastal loads would be 800 to 1000 miles. For transmission distances this long, a dc transmission line is economically feasible. The corridor used for the Colstrip transmission lines could be used for this dc line. For this reason, one of the circuits on the double-circuit towers built by BPA for Colstrip transmission may be built for future conversion to dc operation.

DESCRIPTION OF THE PROPOSED TRANSMISSION FACILITIES

Most of the material in this section has been compiled directly from the Westinghouse Report (WESD/AEA 1973) and the State of Montana Draft EIS (DNRC/DEIS 1974).

TRANSMISSION LINES

Location Criteria

The two 500-kV transmission lines between Colstrip and Hot Springs would be located to minimize environmental impacts to the greatest feasible extent, utilizing the most viable engineering methods and technology.

Existing transmission lines can affect the location of new lines in two contradicting ways: (1) system reliability requirements may dictate locating new lines away from existing lines, and (2) environmental impact considerations may call for placing new lines as close as possible to existing lines.

Because the two lines proposed in this study have an electrical capacity considerably greater than any of the existing lines within the study area, the increased reliability to be achieved by avoiding existing lines is not sufficient to make such avoidance an important factor in locating the proposed lines. Conversely, because the proposed lines are considerably larger than existing lines and of an entirely different design, much of the advantage of closely paralleling existing lines to reduce impact is lost. This is particularly true in open flat terrain or in areas where the principal impact is aesthetic. However, in areas requiring extensive access roads or where wildland intrusion is of concern, closely paralleling smaller existing lines can still significantly reduce the impact of new line construction.

Design Criteria

Right-of-Way

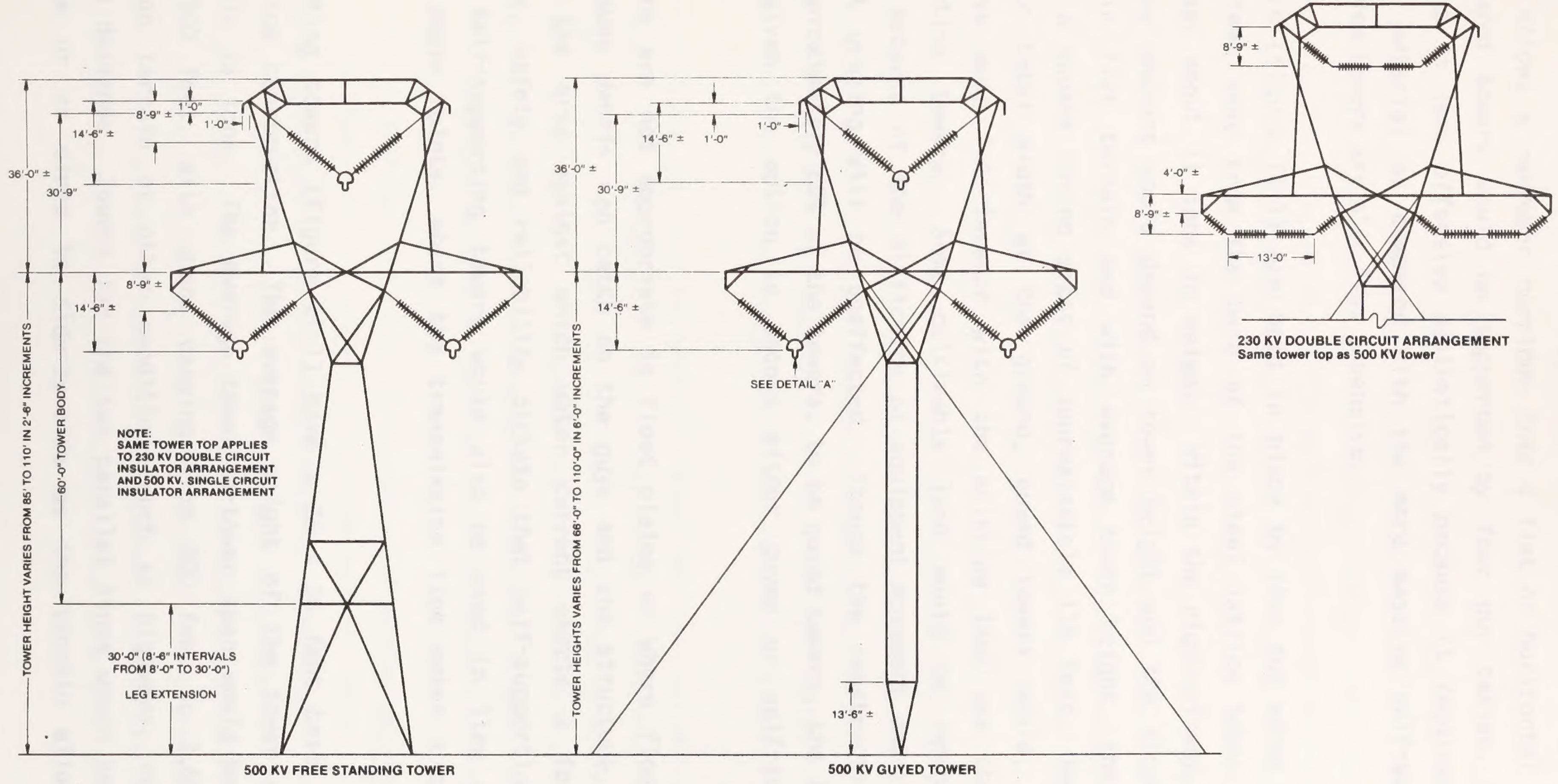
A single 300 foot wide right-of-way is planned for the two parallel transmission lines west of Broadview. East of Broadview, one Colstrip to Broadview line has been constructed and is presently operating as a double circuit 230-kV line. Additional right-of-way would be acquired to bring total right-of-way width to 300 feet. Within the right-of-way, towers will be centered with a typical distance of 140 feet between transmission line centerlines. This centerline distance may vary depending on the terrain.

Right-of-way width was established after consideration of conductor "blow-out" (lateral movement of conductors due to wind), audible noise and radio frequency interference (RFI). Conductor "blow-out" is the most stringent criterion. The amount of "blow-out" is dependent on a number of factors such as distance between towers, line sag and ground clearance, wind speed, ice load and type of connection to the towers. The 140-foot centerline dimension between towers and the 300-foot right-of-way was based on an engineering evaluation of all of the above factors.

Land for the right-of-way would be acquired by easement (see Volume 2, Chapter 2, DNRC/DEIS 1974). Landowners would be free to use land under the lines, but precautions would be necessary. Petrol fueling under conductors or piling dry grass beneath them is not advisable. Water from sprinkler systems operated near high-voltage lines should not touch the conductor because an electric charge could follow the water back to the sprinkler, damage it, and severely shock anyone in contact with it (see "Electrical Considerations," this chapter).

Structure Types

Guyed-delta towers have been selected for the major portion of the transmission route (Figure II-1). The delta configuration for phase



Source WESD/AEA 1973:Figure 3.5-1

SCHEMATIC OF APPLICANT'S TOWER DESIGN
Figure II-1

conductors allows a narrower corridor than a flat or horizontal configuration. Guyed towers would be supported by four guy cables, a design feature that is less offensive aesthetically because it requires a very minimum of material as compared with the more massive self-supporting towers. Guyed towers are also less expensive.

Guyed towers (Figure II-1) are held in place by four guy wires anchored 60 to 70 feet away from the base of the steel lattice tower. Towers would average about 11 tons in weight. Within the right-of-way, spacing of tower guy anchors would depend on tower height and the slope of the terrain. In flat terrain and with average tower height, the anchors would form a square having sides of approximately 118 feet. Because of the greater total width at the ground, guyed towers would, in some areas, cause more interference with the existing land use than would self-supporting towers. Some cultivable land would be removed from production because of the difficulty of equipment movement under the guy cables, but grazing will be unaffected. Though the construction plans call for approximately 80% of the towers, to be guyed towers, the landowner would be given the option to choose either guyed or self-supporting structures.

Guyed towers are not appropriate in flood plains or where flooding may occur, because debris can catch on the guys and the structure, greatly increasing the area against which water current exerts a force. In these areas, safety and reliability dictate that self-supporting towers be used. Self-supporting towers would also be used in lieu of guyed towers at angle points, where the transmission line makes a change in direction.

Self-supporting towers (Figure II-1) have a 26 x 26 foot base, and are steel lattice construction. The average weight of the tower would be approximately 13 tons. The average tower-to-tower span would be approximately 1,300 feet, with spans ranging from 800 feet to 2,500 feet, depending on terrain or other conditions such as highways, railroads, angles, and deadends. Towers for the two parallel lines would be located side-by-side or as close to side-by-side as the terrain allows. The average number of towers per mile would be approximately 4.1 towers per circuit.

Both free-standing and guyed steel towers require a minimum surface area for foundation structure, thereby minimizing the land surface area disturbed. The foundation for each free-standing tower requires four holes for the base supports; guyed towers use five holes, one for the tower base and four with a relatively small diameter for the guywire anchors. All excavations would be small compared to the area of the tower sites. Details of tower assembly and erection are dependent upon construction contractors yet to be selected. Tower foundation designs would depend upon soil and subsurface geology. Typically, the tower foundations would be made of steel-reinforced concrete, with four separate foundations used for each free-standing tower. Associated with each guyed tower would be four guy anchors, usually consisting of either a steel shaft with multiple helixes that are twisted into the ground, or anchor rods that are placed in holes drilled in rock or earth. A center foundation of steel-reinforced concrete placed in a hole below frost line or a steel grillage may be used depending on soil conditions. The anchor type would depend upon subsurface geology.

After completion of the tower foundation and guy anchors, the towers would be erected. Typically, tower components are moved from the nearest staging area and assembled at the site. The method of tower erection would be left to the contractor. Assembly of towers at the tower site reduces the bulk of materials that need to be transported to tower sites, thereby minimizing the width of access roadways.

Conductor Types

Electrical conductors provide the medium through which electrical energy is conveyed in transmission lines. The same arrangement of conductors would be used on both parallel lines. According to preliminary engineering design, each electrical phase of each 3-phase line would consist of a 4-conductor bundle with a subconductor at each corner of a square 18 inches on a side turned at a 45^{o} angle (see Figure II-1).

Individual conductor diameter would be 1.14 inches. Combined weight of the conductors would average approximately 33 tons per mile per phase.

Subconductors would be held to the 18-inch square by spacers or spacer-dampers located at intervals of approximately 200 feet to reduce aeolian (wind) vibration and to keep the subconductors from hitting each other. Conductors would have a standard mill finish which would become oxidized and dull over a period of time, thus reducing reflection.

The power-carrying capacity of each line would vary according to load conditions, but the load-carrying capacity for each line would be approximately 1,500 MVA or 1,400 MW. Depending on series compensation, power-carrying capacity would vary.

Two overhead shield wires would be used to intercept direct lightning strikes to the line. Lightning tends to strike the higher shield wires and the resulting current is then transferred through the wires to the towers into the ground. They would be made of either galvanized steel or Alumoweld (aluminum-coated steel) and would have a diameter of 9/16 inch.

Insulators

A "V" string of electrical insulators would be used to suspend the conductor bundles from the towers while maintaining electrical isolation between the conductors and the tower. Each insulator string would consist of sky-gray or translucent light green standard "bell-shaped" segments having a spacing of 5-3/4 inches and a diameter of 10 inches. The mechanical strength of all insulator strings would conform to National Electric Safety Code (IEEE 1977) requirements. Because of the high elevations, (i.e., 3,000 feet to 7,000 feet), 25 insulator segments per side of the "V" string would be used. This would give a total length of insulators on each side of the "V" of approximately 12 feet. Because of the length of the insulator string in this system, there would little or no possibility that any indigenous birds can span the gap between the energized conductor and grounded parts of the tower and be harmed. The location of insulator strings relative to conductors and the tower is shown in Figure II-1.

A double insulator string in the shape of a "V" would not only support the conductors, but also restrain conductor swinging motion due to external forces such as wind. Sufficient clearance would be maintained between conductors and tower so that flashover would not occur under conditions of 60 miles per hour perpendicular wind velocity and maximum switching surge. Clearance would be adequate for normal operating voltage at maximum winds of 120 miles per hour.

Hardware

The hardware used on transmission lines can have a significant influence on corona and its associated environmental effects and electrical losses. All hardware used on these lines would be required to be corona-free up to the threshold of plume discharge, a partial electrical discharge that is visible as a streamer on the conductors. A discussion of corona can be found in the "Electrical Considerations" section of this chapter.

Support Facilities

Access Roads

Where access roads are planned, maximum use would be made of existing roads, thus minimizing new construction. However, some existing roads may require considerable improvement. Where new access roads are required, they would be located, as far as practical, within the right-of-way, coinciding with the right-of-way centerline. The number of roads would be the minimum practical, consistent with their intended use (e.g., tower construction or tensioning and conductor-stringing). An exception to the "minimum roads" may be in National Forests where the Forest Service may require that a higher quality road be built for use as a logging and/or access road. "Non-bladed" overland travel on marked routes would be done where practical, and "bladed" roads would be constructed only as necessary.

Access road length would be determined by detailed design using the criteria described above. Road design could not be finished until tower locations had been made, but it is anticipated that the average access road length would not exceed that obtained from the following ratios of access road lengths to right-of-way lengths:

Paralleling Existing Lines	Plains	0.4:1
	Mountains	1.0:1
New Construction	Plains	1.1:1
	Mountains	1.6:1

Staging Areas

Staging areas are locations where transmission line parts (towers, conductors, insulators, hardware, etc.) are stored and often subassembled. Actual area locations would be selected by the construction contractor. It would be desirable to locate these areas adjacent to both railroads and existing roadways. The average distance between staging areas for standard methods of construction is in the range of 30 to 35 miles, with land areas in the range of 5 to 10 acres. If staging areas must be separated by distances of 40 to 50 miles, the land area may be up to 15 acres. Small areas located about 10 miles apart would be required if helicopter erection techniques are used. Staging area size would be kept to the smallest practical size. They would be maintained and, after construction completion, vacated and restored as far as is practical.

Communication and Control Facilities

Background - The impact components of communications and control facilities are the radio sites which are located along the general route of the associated transmission facilities. Figure II-2 presents the approximate location of the communication and control facility sites being considered for this project. Figure II-3 lists all of the communication sites investigated and presents some of the principal environmental considerations as they relate to the development of each site. Not all 42 sites would be used for any one communications alternative. These facilities consist of active microwave repeater stations, microwave terminal stations, and passive repeater stations:

Active microwave repeater stations use electrical energy to amplify and retransmit the microwave signals from one station to the next.

Microwave terminal stations use electrical energy to operate the microware radio and its associated equipment. A terminal station communicates with an associated microwave station in one direction only and does not pass on (repeat) microwave signals from one station to the next.

Passive repeater stations are billboard type reflectors mounted on self-supporting structures. Passive repeaters pass on microwave radio signals from one microwave station to another by reflection without the need for electrical power. The size of a passive repeater and where one is used depends on the geometry and distance between it and associated active stations.

Construction Considerations

General construction considerations for communications and control facilities include supervision by responsible personnel to insure proper installation and safety to construction personnel and private property. All overburden from concrete footings and/or site leveling is spread evenly over authorized areas. Cleanup of scrap material resulting from work proceeds concurrently with other work. Scrap material is disposed of in a properly authorized area. Helicopter landing and material staging areas are located so as to minimize long term impacts and utilize existing clearings whenever possible.

COMMUNICATION AND CONTROL FACILITY SITES

- ● Active Microwave Repeater Station [Potential]
- ▪ Microwave Terminal Station [Potential]
- ▲ Passive Repeater Station [Potential]
- ○ Existing Site

Note: Numbers listed with stations are site numbers; see Figure II-3

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

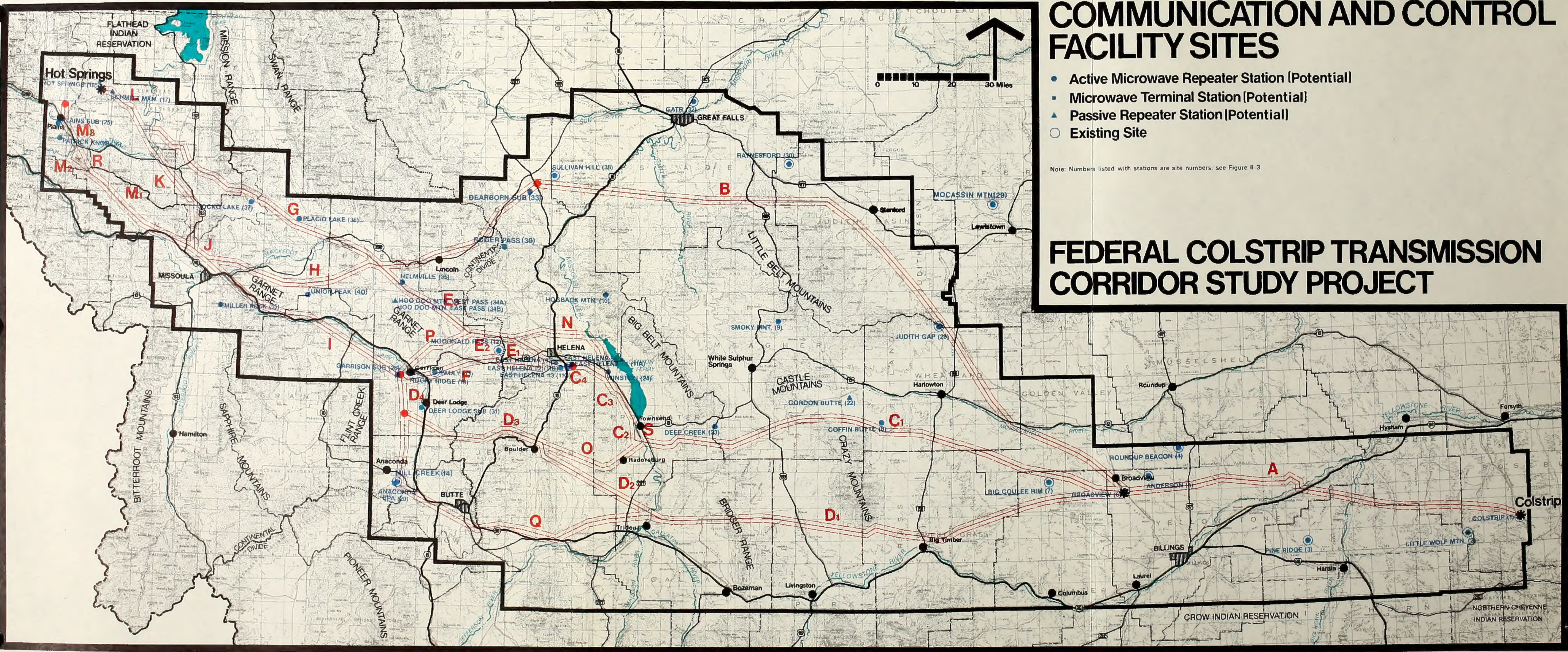


Figure II-2

SITE NO.	STATION NAME	TYPE OF STATION*	STATION STATUS FOR MPCO+	ESTABLISHED ELECTRONICS SITE/CO-USERS	LAND ACQUISITION REQUIRED	OWNERSHIP	ROAD+!	POWER!	SITE DEVELOPMENT		CLEARING		BUILDING+	TOWER(S)+†	ANTENNA ADDITIONS	FUEL STORAGE	ASSOCIATED DEV.	NOTES
									SITE+	HELI-PORT+ (NOTE 1)	ACRE(S)	NO. OF TREES						
1	COLSTRIP	A(T)	E	YES–MPCO	NO	MPCO	E	E	E	E			E	E			NONE	
2	LITTLE WOLF MTN.	A	E	YES–MPCO, CATV	YES–HELIPORT	PRIVATE & MPCO	E	E–OVERHEAD	E	200′ R	CLEAR		E	E			FUTURE P.L. BURIAL–REMOVE STUMPS	ASSOC. DEV. FOR HELICOPTER LANDING
3	PINE RIDGE	A	E	YES–MPCO	NO	MPCO	E	E–BURIED	E	E	CLEAR		E	E			NONE	
4	ROUNDUP BEACON	A	E	YES–MPCO	YES	PRIVATE & MPCO	E	E–OVERHEAD	U	E			N 12′ X 24′	N 70′ S.S.	1 @ 10′	BURY NEW TANK 200 GAL. W.C.	NONE	ENLARGE EXISTING FACILITY
5	ANDERSON	A	E	YES–MPCO	NO	STATE OF M.	E	E–OVERHEAD	E	E			E	E			NONE	
6	BROADVIEW	A(T)	E	YES–MPCO	NO	MPCO	E	E–BURIED	E	E			E	E			NONE	
7	BIG COULEE RIM	A	E	YES–MPCO	YES	PRIVATE (3 OWNERS)	E	E–OVERHEAD	U	E			N 12′ X 16′	N 90′ S.S.	2 @ 10′		NONE	ENLARGE EXISTING FACILITY
8	COFFIN BUTTE	A	N	NO	YES	STATE OF MONTANA	E–IMPROVE 1 MI.	NEW 1.5 MI. OVERHEAD	N	E			N 12′ X 12′	N 30′ S.S.	1 @ 10′ 1 @ 15′	BURY NEW 200 GAL. TANK	SITE LEVELING	
9	SMOKY MTN.	A	N	NO	YES	NATIONAL FOREST	E–IMPROVE 1.5 MI.	NEW 2.0 MI.	N	200′ R	CLEARING SMALL AMT.	SOME	N 12′ X 12′	N 30′ S.S.	2 @ 10′	BURY NEW 200 GAL. TANK	SITE LEVELING	
10	HOGBACK MTN.	A	N	YES–KTCM–TV, USFS L/O	YES	NATIONAL FOREST	E	E–BURIED	N	E			N 12′ X 16′	N 30′ S.S.	1 @ 6′ 2 @ 10′	BURY NEW 200 GAL. TANK	SOME SITE LEVELING EXCAVATION IN ROCK	
11A	E. HELENA NO. 1	A	N	NO	YES	PRIVATE	E	E	E	E			N 12′ X 12′	N 20′ S.S.	1 @ 6′		SITE LEVELING DONE DURING SUBSTATION DEVELOPMENT	
11B	E. HELENA NO. 2	A	N	NO	YES	PRIVATE	E	E	E	E			N 12′ X 12′	N 20′ S.S.	1 @ 6′			
11C	E. HELENA NO. 3	A	N	NO	YES	PRIVATE	E	E	E	E	SOME		N 12′ X 12′	N 20′ S.S.	1 @ 6′			
12	McDONALD PASS	A	E	YES–MTN BELL, CATV, MPCO, USFS, STATE	NO	MPCO	E	E–OVERHEAD	E	E			E	IMPRV. EXST. OR N 30′ S.S.	1 @ 10′ 1 @ 15′			ENLARGE EXISTING FACILITY
13	PAULY	A	E	YES–MPCO, BPA	NO	MPCO	E	E–OVERHEAD	N	E			E	IMPROVE EXISTING OR N 30′ S.S.	2 @ 6′ 1 @ 8′ 1 @ 12′			ENLARGE EXISTING FACILITY
14	ANACONDA MILL CREEK SUB.	A(T)	N	YES–MPCO	YES	MPCO	E	E	N	E			N 12′ X 24′	N 20′ S.S.	1 @ 8′			
15	MILLER PEAK	A	N	YES–BPA	YES	NATIONAL FOREST	E	E–BURIED	N	E	100′ X 100′	10 @ 40′	N 12′ X 12′	N 50′ S.S.	2 @ 12′	BURY NEW 200 GAL. TANK	SOME SITE LEVELING	
16	PATRICKS KNOB	A	N	YES–BPA, TV DIST, USFS, COUNTY	YES	NATIONAL FOREST	E	E–BURIED	N	E			N 12′ X 16′	N 160′ S.S.	1 @ 10′ 1 @ 12′	BURY 200 GAL. TANK	COULD USE BPA TWR; SITE LEVELING	
17	SCHMITZ MTN.	P	N	YES–BPA, OLD USFS, L/O	YES	PRIVATE	N/R–HELICOPT. CONST.	N/R	LEVELING	E	SOME	5 @ 30′			24′ X 30′			
18	HOT SPRINGS	A(T)	N	YES–BPA	YES	PRIVATE	E	E	E	E			N 12′ X 16′	N 50′ S.S.	1 @ 10′	EXISTING POWER	SUBSTATION DEV. WILL DO MW SITE	
19	ROCKY RIDGE	A	N/A	YES–BPA, MPCO	N/A	BPA	E	E	N/A	E	NO	NO			0			IF MPCO. MEETS AT ANACONDA CKTS GO THROUGH ROCKY RIDGE ON BPA SYSTEM
20	ANACONDA(BPA)	A	N/A	YES–BPA	N/A	BPA	E	E	N/A	E	NO	NO			0			
22	GORDON BUTTE (DOUBLE PASS)	P, P	N	NO	YES	PRIVATE	E	N/R	N	E	NO	NO			2 @ 30′ X 40′			CLOSE COUPLED ON SAME SITE
23	DEEP CREEK	A	N	NO	YES	NATIONAL FOREST	E–IMPROVE 1 MI.	E–ADD 1 MI. OVERHEAD	N	E	NO	NO	N 12′ X 12′	N 30′ S.S.	1 @ 8′ 1 @ 15′	BURY 200 GAL. TANK		
24	WINSTON	A	N	YES–MTN. BELL, BN	YES	PRIVATE	E	E–OVERHEAD	N	E	200′ X 200′	NO	N 12′ X 12′	N 60′ GUYED	1 @ 6′ 1 @ 8′	BURY 200 GAL. TANK	RELOCATE PWR. POLE & LINE TERMINATION	
25	PLAINS SUB.	A(T)	N	NO	YES	PRIVATE	E	E	N	E			N 12′ X 16′	N 30′ S.S.	1 @ 6′ MPCO 1 @ 6′ BPA	NO	DEVELOPMENT ASSOC. WITH SUBSTATION	
26	GARRISON SUB.	A(T)	N	NO	YES	PRIVATE	E	E	N	E			N 12′ X 16′	N 30′ S.S.	1 @ 6′	NO	DEVELOPMENT ASSOC. WITH SUBSTATION	
28	JUDITH GAP	A	E	YES–MPCO	YES	MPCO PRIVATE	E	E–OVERHEAD	U	E	NO	NO	N 12′ X 16′	N 30′ S.S.	2 @ 10′	E	SOME LEVELING	ENLARGE EXISTING FACILITY
29	MOCCASIN MTN.	A	E	YES–MPCO, REA	YES	MPCO BLM	E	E–OVERHEAD	U	200′ R			N 12′ X 16′	N 30′ S.S.	1 @ 10′ 1 @ 12′	E	SITE LEVELING EXTENSIVE	NEW SITE SHORT ROAD ENTRY FOR CONST. ENLARGE EXISTING FACILITY
30	RAYNESFORD	A	E	YES–MPCO	YES	MPCO PRIVATE	E	E–OVERHEAD	U	E	NO	NO	N 12′ X 16′	N 30′ S.S.	1 @ 10′ 1 @ 12′	E	SOME LEVELING	ENLARGE EXISTING FACILITY
31	DEERLODGE SUB.	A(T)	N	NO	YES	PRIVATE	E	E	N	E			N 12′ X 16′	N 30′ S.S.	1 @ 6′	NO	SUB. DEV. COVERS MW, PWR. FROM SUB.	
32	GATR	A	E	YES–MPCO, USAF	YES	PRIVATE	E	E–OVERHEAD	U	E	NO	NO	N 12′ X 16′	N 30′ S.S.	2 @ 10′	NO	NO	ENLARGE EXISTING FACILITY
33	DEARBORN SUB.	A(T)	N	NO	YES	PRIVATE	E	E	N	E	NO	NO	N 12′ X 16′	N 30′ S.S.	1 @ 6′	NO	SUB. DEV. COVERS MW, PWR. FROM SUB.	
34A	HOO DOO MTN. (WEST PASS)	P	N	NO	YES	BLM	N/R	N/R	N	200′ R	100′ X 100′	YES			1 @ 30′ X 40′		TREE CLEARING	
34B	HOO DOO MTN. (EAST PASS)	P	N	NO	YES	BLM	N/R	N/R	N	200′ R	100′ X 100′	YES			1 @ 30′ X 40′		TREE CLEARING AMT. UNKNOWN	
35	HELMVILLE	A	N	YES–BN	YES	USFS HELENA N.F.	E	E–BURIED	N	200′ R	100′ X 100′	YES SOME	N 12′ X 12′	N 60′ S.S.	2 @ 10′	200 GAL. BURIED TANK		
36	PLACID LAKE	A	N	YES–BN	YES	PRIVATE	E	E–BURIED	N	200′ R	100′ X 100′	YES SOME 20 MAX.	N 12′ X 12′	N 60′ S.S.	1 @ 6′ 1 @ 8′	200 GAL. BURIED TANK	MINIMAL GRADING	
37	JOCKO LAKE	A	N	NO	YES	PRIVATE OR NATIONAL FOREST	E–ADD .5 MI.	NEW 15 MI.	N	200′ R	250′ X 250′	YES THICK 50′ HIGH	N 12′ X 12′	N 80′ GUYED	1 @ 6′ 1 @ 12′	200 GAL. BURIED TANK	POSSIBLE EXTENSIVE LEVELING	
38	SULLIVAN HILL	A	E	YES–MPCO, CATV	YES–HELIPORT	MPCO PRIVATE	E–IMPROVE 1 MI.	E–OVERHEAD	U	200′ R		YES FOR HELIPORT	E	REPLACE W/40′ S.S.	2 @ 8′ 1 @ 10′		CLEAR ABOUT 10 TREES SOME EXCAV. IN SOLID ROCK	ENLARGE EXISTING FACILITY
39	ROGERS PASS	A	N	YES–BN	YES	STATE OF MONTANA	E	E–BURIED	N	200′ R	100′ X 100′	YES 20 @ 20′	N 12′ X 12′	N 30′ S.S.	1 @ 8′ 1 @ 10′	200 GAL. BURIED TANK	SOME LEVELING	
40	UNION PEAK	A	N	YES–STATE MW & L/O	YES	PRIVATE	E	NEW 15 MI. BURIED	N	200′ R	200′ X 200′	YES 10 @ 40′	N 12′ X 12′	N 70′ S.S.	1 @ 8′ 1 @ 12′	200 GAL. BURIED TANK	EXTENSIVE LEVELING	
41	EAST HELENA	A	N	NO	YES	PRIVATE	E	E	N	E			N 12′ X 12′	N 30′	2 @ 6′ 1 @ 8′	200 GAL. BURIED TANK	DEV. ASSOC. W/ SUBSTATION	5 MI. RADIUS INCLUDES 11A, B & C
42	EAST HELENA PASS	P	N	NO	YES	PRIVATE	E	N/R	N	E	SMALL AMT.				24′ X 30′			

* A=ACTIVE, P=PASSIVE, T=TERMINAL + E=EXISTING, N=NEW, N/A=NOT APPLICABLE, U=UPDATE EXISTING FACILITIES † S.S.=SELF SUPPORTING ! N/R=NOT REQUIRED
NOTE 1. E MEANS ADEQUATE LANDING SPACE WITHOUT CLEARING OR GRADING.

COMMUNICATION SITES DATA MATRIX

Figure II–3

Active microwave repeater and terminal station construction considerations: Microwave and repeater stations facilities require suitable roads for access during construction and periodic year-round maintenance. Helicopter landing space is also required for emergency maintenance access during adverse weather. Installation of an electrical power line provides energy for the operation of repeater and terminal stations. Station buildings are normally single story structures with 100 to 300 square feet of floor space as required to house the necessary radio equipment and self-contained backup emergency power equipment. Both station types also require adequate fuel storage for an emergency generator and a tower to support the necessary antennas.

Surveying and appropriate acquisition is obtained before construction begins on the following items: power lines, access roads, helicopter landing areas, and microwave site locations. Once construction begins, all areas of the construction project would be installed as per the installation drawings supplied for each particular site. A typical microwave terminal or repeater installation would at most include the following: surveyor-installed property corner markers; adequate road access; adequate helicopter landing area; area for site installation (less than 4 per cent slope). This leveled area for the site would be fenced off to stop unauthorized entry. The soil inside the fence would be sterilized for fire prevention and to help stop the growth of weeds and then gravelled. The 100 to 300 square foot communications building would house the radio and associated equipment plus the self-contained backup electrical power source. An on-site storage tank would supply fuel for the emergency backup engine generator. Typical steel microwave communications towers are either self-supporting or guyed. Typical parabolic microwave antennas would be mounted on the tower and where applicable, a typical two-way radio antenna would be mounted on the tower. Guy anchors for guyed communications towers would be fenced to keep out domestic or game animals.

Passive repeater construction considerations: A passive repeater can be constructed and maintained utilizing existing roads or by use of helicopters which require no new road construction. Maintenance access is infrequent, such as once every year.

Surveying and appropriate acquisitions are obtained before construction begins on access roads, helicopter landing areas and passive repeater locations. All areas of the construction project would be installed as per the installation drawings supplied for each passive repeater site. A typical passive repeater installation at the most would include surveyor-installed property corner markers, adequate access roads or helicopter landing areas, and a typical billboard reflector mounted on a self-supporting tower.

Construction Sequence

Construction can be categorized into the major areas of: construction survey and staking, clearing, road construction, tower construction and erection, stringing of conductors, and clean up and restoration.

At this time, the Applicant envisions the transmission lines being built by three prime contractors. Based on this approach, the new lines along the proposed corridor would be built by one contractor from Colstrip to Lennep, a second contractor from Lennep to Nevada Lake, and a third contractor from Nevada Lake to Hot Springs. The location of these contractors' construction headquarters is the individual company's responsibility and would be determined at a later date.

Surveys and Staking

Surveying and staking is required for all rights-of-way, tower sites, roads, substations, and other engineered or controlled facilities associated with the transmission line project such as communication sites, staging areas, helicopter landing areas, wire stringing sites, and others.

The surveyors and their equipment are the first on the scene. Construction surveys are usually more detailed and intensive than design surveys. Some clearing and much mobility along the right-of-way is required. The crews are small, consisting of about three or four people.

Other engineering data may be necessary, such as that from tower foundation investigation, which may be conducted during the construction survey phase.

Clearing

Clearing includes all operations needed to open up the sites described above to enable construction and future operation of the planned facilities. Clearing consists primarily of vegetative removal or modification such as crushing. Man-made objects such as buildings or fences may require modification, moving, or demolishing. Sometimes other natural barriers, such as rock outcroppings, are cleared.

Equipment ranges from hand tools to large bulldozers. Crew sizes vary with equipment used, vegetative density, and complexity of the clearing operation. The number of workers may be from 3 or 4 to 24 or 30. The vegetative material removed must be disposed of or moved away from construction areas. Disposal may be by burning, burying, chipping, or movement to a remote disposal site. Sometimes material is piled, to be scattered in open areas after construction. Marketable timber is usually sold.

The proposed transmission line right-of-way is a single 300-foot wide path for both lines. If the total 300 feet were cleared, the area cleared would be slightly over 36 acres per line mile. Selective clearing outside normal rights-of-way may be needed to remove danger trees such as large snags or other tall trees which could fall onto conductors or towers. Numbers of danger trees cleared would vary according to timber density, height of trees, growth rate of trees and terrain.

Tower sites require space for assembly and erection of towers up to 150 feet high. The tower tops are about 65 feet wide. Flat bed trucks and large cranes with booms over 150 feet are needed at tower sites so adequate clearing is needed for this type of equipment. If the 300-foot right-of-way is fully cleared, there should be adequate space within this area for tower sites; if not, tower site clearing is at least 150-foot square or about a half acre. Tower sites are usually cleared more completely than line rights-of-way, especially under the tower and where cranes are located.

If counterpoise is required because the electrical resistivity of the soil is too great to allow adequate grounding of the tower, then, depending upon the resistivity of the soil, some additional clearing may be required to allow the installation of from one to six 250-foot lengths of bare aluminum wire (counterpoise). The burial can be by hand-trenching, plowing in by tractor or caterpillar, or by machine-trenching. Clearing is required to allow movement of the installing vehicle.

Road Construction

Existing roads may require widening, additional gravel, more drainage, or other reconstruction because of the line project. New roads may be needed. Temporary roads are usually required for line construction.

Rock required for road construction and improvement would come from local quarries or sites acquired by the contractor. Existing and new sites should be as close to the construction activities as possible.

Equipment and workers are those normally used for rural road construction ranging from hand tools to bulldozers, drag lines, dump trucks, graders, and possibly large gravel crushing equipment. Total road construction crews may range into the twenties in number. Many of the same workers and equipment used for clearing can also be used for construction.

Tower Construction and Erection

This includes tower component assembly, tower assembly, installation of footings and guys, tower erection, and counterpoise installation (tower grounding).

After tower sites are cleared, excavation for footings is done. Sometimes blasting is required. Some site leveling with a bulldozer may be required for the tower and the erection crane. Excavation equipment may include backhoes, dump trucks, power augers, wagon drills, bulldozers, compressors, and blasting equipment. Augers and wagon drills are mounted on large trucks such as 5-ton 6 x 6's. Crews range from a few to a dozen and may include those employed in other construction stages.

Footing forms are installed and footings are placed with concrete hauled in conventional concrete trucks. The concrete comes from batch plants or ready mix plants which must be located near enough to insure proper concrete quality. Batching can be done on the site by hauling in the component materials but is less efficient.

Footing and concrete work requires four to six workers at the tower site in addition to truck drivers. Other workers and equipment are needed at the batch plant to operate the plant and haul in sand, gravel, cement, and water. Materials are stockpiled at the batch plant, where the equipment consists of front-end loaders, cement transports, tank trucks, and dump trucks, as well as the plant itself.

Tower components are normally subassembled at the tower site. If erection is done by helicopter, subassembly is done at staging areas located near the line. On guyed towers, the subassemblies are bolted together at the tower site to complete the tower. Next, the tower is lifted into place by a large crane and held on its footing until the guys are attached. On towers that are self-supporting, assembled sections are bolted together with the use of a crane until the tower is completed. In addition to cranes, tower erection equipment includes bulldozers for leveling crane sites, rigging trucks and miscellaneous vehicles such as pickups. Crew size may range up to a dozen or more and the workmen are usually highly specialized workers. Approximately 10 percent of the towers on a transmission line require counterpoise. Each of the 250-foot lengths of bare aluminum wire is attached to the tower at one end and to a galvanized steel ground rod driven into the earth at the other end. The counterpoise wires are installed at a minimum depth of 12 inches in uncultivated soil, 24 inches under roads, and 30 inches in cultivated soil. A trencher or a vibratory plow is normally used for this installation. If solid rock is encountered, the wire is usually layed in cracks or on the surface with loose rock or soil placed on the wire to hold it in position.

Conductor Installation

Guard structures are built adjacent to highways, railroads, powerlines, and other barriers as required to prevent mutual damage or interference during stringing of socklines and conductors. Equipment used to erect guard structures includes power auger trucks, pole trailers, and crew-haul vehicles. Four or five personnel are normally employed to erect guard structures.

Conductor pulling sites are required approximately every three miles along the line. A high volume of traffic and activity occurs at these sites. Equipment employed at these locations includes wire trailers, pullers, tension machines, crawler tractors, and crew-haul vehicles. The size of the stringing crew would vary, but normally eight to twelve employees would be used.

Prior to stringing the socklines, the insulator strings and stringing sheaves are installed on the towers. These may be installed at the time the towers are erected or by a separate three or four-man crew after erection.

Socklines are strung from a pulling site through the sheaves to the next pulling site. These lines are normally placed in the sheaves by utilizing a helicopter. A single sockline must be used for each phase of conductor to be pulled.

Conductor pulling commences after the socklines are strung. This operation requires that pullers and tension machines used to keep the conductors clear of the ground be placed on tangent with the towers.

It is necessary to install splice connectors or field sleeves wherever separate conductor lengths are joined. These splices must be installed prior to final tensioning or sagging of the conductors to their final height.

Subsequent to sagging, the conductors are marked and installed in the assemblies used to attach the conductors to the insulator strings. This operation is referred to as clipping. The subconductors within each phase are then spaced by means of spreader bars. Jumpers are made up and installed at all deadend towers. These three operations each require a four or five-man crew.

After installation of the terminal substations and any required line switches, the lines are test-energized prior to operation at normal voltages.

Clean Up and Restoration

Clean up is performed for each construction phase. However, final clean up involves restoration and rehabilition as needed to restore the right-of-way as nearly as possible to its original condition. Crew and equipment are similar in makeup and size to those used in clearing and excavation. All debris, unused material, and unneeded equipment is removed. Final slash processing is completed such as scattering over open areas. Soil is replaced where severely disturbed on roads, tower sites, borrow pits, batch plant sites, and other sites. Seeding or planting is carried out as needed. Erosion protection is developed, including fertilizer and mulch use, if needed. Temporary roads are obliterated and/or closed with barriers and signs. Final fence, gate, and cattleguard adjustments or repairs are made. Permanent roads are brought up to maintainable standards and conditions.

Operation and Maintenance Characteristics

Maintenance includes all functions needed to keep the lines and associated facilities in operation throughout their lifetime. Some maintenance, such as road maintenance, is required during and after construction of the lines. Other maintenance includes line patrol or inspection, vegetative management, and structural and electrical maintenance. These operations are carried out both on a scheduled and emergency basis.

Vegetation management by the Applicant will not include herbicide use.

Electrical Considerations

Corona

Corona can be defined as an electrical discharge that occurs when the voltage applied to a conductor exceeds the dielectric strength of the surrounding insulation. For high voltage overhead power lines, corona is produced when the dielectric strength of the air is exceeded. This ionizes a small volume of air surrounding the conductor and ozone and nitrous oxides are formed (see "Electrochemical Reactions," this chapter). With foul weather conditions and a dark night, corona may be visible. It appears as bluish tufts or streamers emanating from the conductor.

Small protrusions or irregularities normally exist on conductors and supporting hardware. These become spot sources of corona at lower voltages than the general corona onset voltage of the line. Irregularities may consist of bugs, bird droppings, dust, dew, snow, water droplets, or burrs and nicks on the conductors; hence, wet weather conditions increase corona generation. Since any corona activity involves a power loss and RI,TVI and audible noise, it is standard engineering practice to design a transmission line for essentially zero corona during normal operating conditions. This is often accomplished by increasing the number of separate conductors in each phase. Transmission lines of 500-kV, with three or more conductors per phase, have low corona levels.

Audible Noise

Intense corona activity will often produce a waterfall sound. In dry weather, the low corona level could produce an occasional popping or snapping sound, but will be too quiet to measure on the dBA scale (the sound level scale which corresponds to human hearing). During rain, the transmission line-caused noise can be distinguished from the rainfall at locations near the line. During rainfall, the average noise level (L50) from the line would be about 44 dBA, at a reference distance of 100 feet from the centerline. This level decreases about 3.4 dBA for every doubling of the reference distance.

The Environmental Protection Agency recommends a noise limit of 55 dB Ldn for new facilities. This is equivalent to an average noise level (L50) of 48 dBA. Noise levels from 40-50 dBA are regularly experienced in an average residential home.

Radio and Television Interference

Television reception near the proposed 500-kV transmission line would not be affected during fair weather, but some interference (TVI) may occur during foul weather, depending upon the amount of corona. The TV channels most affected by corona interference are those of lowest frequency, channels 2-6. In FCC designated reception areas, Grade B (224-2509 microvolts per meter) and Grade C (51-223 microvolts per meter) television interference on channels 2-6 may be noticeable to 1,000 feet from the operating line. The presence and degree of interference is dependent on the strength and quality of the signal being received, the distance from homeowner's TV antenna to the transmission line, the receiving antenna's orientation with respect to the line, and the front to back ratio (rejection characteristic) of the homeowner's antenna.

The Montana cities in the study area served by television chaknels 2-6, that are in Federal Communications Commission (FCC) designated reception areas Grades B and C, are listed below with their respective transmitter signal strengths. The 1978 Broadcasting Yearbook lists these major cities (Page B-114). Also listed in the Broadcasting Yearbook are major areas of reception shown geographically, including those served by cable. Radio/TV reception minimum coverage areas for Grade B, as well as a description of the quality of reception by grades, are shown in the Montana State DEIS, Vol. 4 (1974).

City	Channels	Transmitter Signal Strength (kW)
Billings	KTVQ - Ch. 2	100
Great Falls	KRTV - Ch. 3	100
	KFBB-TV - Ch. 5	100
Miles City	KYUS-TV - Ch. 3	10
Butte	KXLF-TV - Ch. 4	100
	KTVM - Ch. 6	100
Glendive	KXGN-TV - Ch. 5	14.8

The calculated line interference during rain is 14 microvolts per meter at a reference distance of 100 feet from the centerline and a frequency of 75 megahertz. For every doubling of the reference distance, the interference level is reduced by 50 percent. At 400 feet from the centerline, the interference would be less than four microvolts per meter.

Interference from the transmission line would not be noticed where the ratio of TV signal to line interference (SNR) is at least 100:1. Any TVI problems caused by the transmission line could be mitigated, generally by relocating or replacing the receiving antenna. Efforts would be made to locate the line away from homes, consequently few if any problems with TV reception are anticipated.

The corona factors which affect TV reception also affect AM radio reception. For acceptable reception of AM radio, a SNR of 15 or more is adequate. At a reference distance 100 feet from the centerline, the radio interference (RI) of the line at 834 kHz would be about 56 microvolts per meter, fair weather and 1,000 microvolts per meter, foul weather. These values decrease by 50 percent for every doubling of the reference distance. Based on the weather history in the vicinity of the proposed line, foul weather occurs about four percent of the time. In remote areas where radio signal strengths are low, some interference to AM radio reception may be noticeable out to 500 feet from the line during foul weather.

Because of its modulation characteristics, FM radio reception is not subject to transmission line corona interference. FM reception can usually be improved, however, with the proper selection and location of a receiving antenna.

Electrochemical Reactions

In the small volume of air surrounding a conductor where corona is present, chemical reactions take place. They include the production of ozone and nitrous oxides. Experience and studies to date indicate that the amounts of oxidants produced by transmission lines have no adverse effects on humans, animals, or plants (Frydman, et al. 1974; Sebo, et al. 1975; Lee 1977).

Electrostatic and Electromagnetic Field Effects

Description - Field effects from transmission lines stem from electric and magnetic fields at the power frequency of 60 Hz in the proximity of high-voltage conductors carrying electric currents. The high voltage creates the electric field. Currents flowing in the conductors are the source of the magnetic field.

A useful parameter to quantify the electrostatic and magnetic effects associated with these respective fields is the magnitude of the unperturbed field; that is, the magnitude or strength of the field, where no large objects are present to interact with the field. In general, electric fields associated with transmission lines are expressed in units of kilovolts/meter (kV/m) and magnetic fields in gauss (G). The earth's average dc electric field at ground level is 0.13 kV/m. Beneath thunderclouds, the field may reach 3 kV/m even in the absence of lightning (Polk 1974). The dc magnetic field of the earth is about 0.6 G.

The presence of transmission line electromagnetic fields is masked by the more obvious effects of the electrostatic fields. Grounding procedures used to eliminate electrostatic shocks have an equivalent effect on the magnetic component. One instance where an electromagnetic field can cause problems, independent of the electrostatic field, is on nearby wire communication lines (USDI, Bureau of Land Management 1975). This aspect is described in the "Effects of Electrical Facilities" section of Chapter III.

The electric field (voltage gradient) from a high-voltage conductor is measured or calculated at standard heights above the ground. This permits comparisons to be made between different lines. The electric field strength one meter (3.28 feet) above ground (ground gradient) has been demonstrated to be a valid parameter for the prediction of electrostatic effects (Deno 1974; Bracken 1975). For a given conductor-to-ground height, the strength of the electric field does not vary more than 10 to 15 percent for heights up to 10 feet.

Electric fields can be accurately calculated, which allows transmission lines to be designed with known field strengths at ground level. The major factor influencing the maximum intensity of the electric field at ground level is the height of the conductor above ground. At distances greater than about 75 feet beyond the outside conductor, conductor height does not have much influence on ground gradients for a given configuration.

A second factor that determines field strength is the conductor configuration -- the spacing and arrangement of the conductors. The electric fields of the three phases of a single high-voltage line tend to cancel one another. In the delta (triangular) configuration planned for this line, the three phases are more compact than in a flat configuration. Thus, electric field strength near the ground for this configuration is less than that of a comparable flat configuration at the same height.

Shrubs, trees, fences, distribution lines, or other objects that normally stand on or near the right-of-way, reduce the strength of the ground gradient. Typically, under this energized 500-kV line, maximum levels of ground gradient would be 7.6 kV/m near midspan at a point slightly beyond the outer conductor, and 2.0 kV/m at a reference distance of 75 feet from the centerline.

The presence of an electric field under a transmission line is sometimes demonstrated with a hand-held fluorescent tube. The tube may light up. This phenomenon has been associated with transmission lines and distribution lines. It is also possible to light a fluorescent tube in other ways, such as holding it near a television set (Morgan 1975). In these demonstrations, the illumination would be much less than that produced by normal use.

Shock Potentials - When a conducting object, such as a vehicle or person, enters an electric field, currents and voltages are induced in the object. The induced current varies with the electric field strength, the frequency of the field, and the size and shape of the object. If the object is grounded, then the induced current flows to ground. This is called the short-circuit current of the object.

Short-circuit current for some objects in a 60 Hz electric field is tabulated below in milliamperes (mA):

Object	Field Strength (mA)		
	1 kV/m	2 kV/m	7.6 kv/m
Person (5'9" height)	0.016	0.032	0.12
Sedan	0.11	0.22	0.84
Camper truck	0.28	0.56	2.13
Large trailer truck (51 ft long)	0.6	1.2	4.6

As indicated by the tabulated values, the total short-circuit current for a given object varies in direct proportion to the field strength. When a person becomes a path-to-ground for short-circuit current from an insulated object, steady-state current shocks may occur. The amount of current that will flow through a person contacting an energized object is determined by how well both the object and the person are insulated from ground. The short-circuit current tabulated above is the maximum current an individual could experience in this situation. The values represent worst case estimates. Conditions conducive to maximum current flow rarely happen. The mean perception level for a 180-pound man is about 1.0 mA. It is about two-thirds of this value for a 120-pound woman (Keesey and Letcher 1970).

Primary shocks can produce direct physiological harm. Their lower level is described as the current at which 99.5 percent of subjects can voluntarily "let go" of the shocking electrode. Keesey and Letcher (1970) fixed the mean let-go level for 180-pound men at 9 mA and for 120-pound women at 6 mA. Their estimate for children was 5 mA. They recommended that the children's level be used as a safety standard for the general public; 5 mA is the limiting value for electrostatically induced currents under transmission lines, as established by the National Electrical Safety Code (1977). In the list of objects tabulated above, only the 51 foot long trailer truck, well insulated from ground, would approach the 5 mA limit under the proposed 500-kV line. Conductors for this 500-kV transmission line would be built with higher clearances over road crossings and freeways, where these trucks primarily travel. The extra clearance would reduce the maximum ground gradient level to values below 7.6 kV/m. Problems associated with electric shocks from induced currents under transmission lines have been recognized for years (IEEE W.G. 1972). Stationary objects on the right-of-way such as fences, metal roofs and antennas would be grounded to prevent shocks.

Secondary shocks cause no direct physiological harm, but they may annoy a person and cause muscles to react involuntarily. Though difficult to define precisely, the lower mean shock level for men is around 1.8-2.0 mA (EPRI 1975).

An extra high-voltage line imparts little energy to an insulated person standing on the ground under the line. The amount of energy stored on the person is so low that one would receive, under the worst conditions, only a minor secondary shock. In tests simulating the spark discharge from an umbrella to a grounded person in a field strength of 2.63 kV/m, Takagi and Muto (1971) found the increase in blood pressure (6-7 mm Hg) following shock to be about half the increase in blood pressure brought on by a cold day (14 mm Hg). They also compared the increase in blood pressure with that obtained after 1 or 1-1/2 minutes of going up and down steps (13-14 mm Hg). They concluded that "if the field intensity is less than 3.0 kV/m, the influence the discharge stimulation may have upon people remains, physically as well as mentally, within the range of physiological changes occurring daily around us and are of fugitive phenomena."

Irrigation Precautions - Metal irrigation systems pose a potential shock hazard because of their size and possible isolation from ground. However, with simple precautions, the hazard is eliminated.

When moved manually, irrigation systems usually are laid on soil. Because of the ground contact, they present little or no shock hazard.

Great care should be exercised when handling lengths of metallic pipe near any overhead conductors. The pipe should be kept or moved in a horizontal position. In this instance, the major danger near an overhead power line is the chance that a person may up-end a long section of pipe into the conductor overhead. Lower voltage lines are also dangerous in this regard, especially since the conductor-to-earth distance, or clearance, is less.

Irrigation systems which move on wheels can be shock hazards if well insulated from ground and parked parallel to and within 50 feet of a high-voltage transmission line. A 1,000-foot length of 5-inch irrigation pipe, deliberately insulated from the soil and parked 12 feet beyond the outer conductor of a 500-kV line, has a short-circuit capability of about 3 mA.

Some systems, such as large circular sprinklers, use an 8-inch diameter pipe carried 12 feet above the soil. Such a system will have a short-circuit current appreciably greater if insulated from ground. However, with agricultural conditions, it is difficult to produce a high degree of insulation. The insulation is influenced by the type of wheels (metal or rubber), moisture conditions in the soil, and other contact points to ground, such as the central pivot point on a circular system.

Vermeer type high-pressure, high-velocity systems should be operated at distances sufficient to avoid direct contact between an unbroken water stream and the overhead conductors. A solid stream of water should never be directed close to the conductors. Because of the small size of a vermeer system, shock problems do not ordinarily occur.

SUBSTATIONS

Substations may perform one or more of the functions of (1) control, (2) electrical compensation and (3) distribution of bulk electric power from transmission lines. They may contain circuit breakers, shunt reactors, series capacitors, and transformers as well as related control, metering, and communications facilities. The criteria for specifying these functions are established by minimizing the environmental effects and optimizing the performance, reliability, and economics of the transmission system with regard to its immediate and long-range future requirements. The control function consists of switching and terminating transmission lines of the same voltage. Compensating for the inductance and capacitance inherent in long transmission lines is performed by shunt reactors and series capacitors: shunt reactors limit the voltage rise along the line, thereby maintaining good voltage regulation; series capacitors compensate for the inherent inductance in the line and provide for more electrical transmission capacity from a given line. The transformation function consists of reducing the voltage level so that power may be retransmitted or distributed locally. Substation functions have been combined in the proposed system so that for any plan-of-service only three substations and a terminal substation at Hot Springs are required.

Substations provide the locations for (1) equipment to compensate for undesirable electrical features associated with long transmission lines, (2) equipment for planned or future power withdrawal and (3) electrical switches to enhance system reliability and safety.

Existing Sites and Facilities

Existing substations common to all system alternatives considered in the Applicant's proposal are located at Colstrip, Broadview, and Hot Springs. The existing substations at Colstrip and Broadview are owned and operated by the Applicant.

The Colstrip Substation integrates the Colstrip generating units into the MPC transmission system. Power from existing units 1 and 2 is integrated at 230-kV, part of this is transmitted to the Billings area and part is distributed at 115-kV through stepdown transformers. Units 3 and 4 would be integrated at 500-kV. The ultimate development of the Colstrip Substation would include eight 230-kV and seven 500-kV circuit breakers. Both 230-kV and 500-kV sections of the substation would operate as a breaker-and-one-half. Power from units 1 and 2 would be stepped up to 500-kV through two 3-phase 500-kV autotransformers. Two 500-kV shunt reactors (one on each line to Broadview) and four tertiary connected, switched shunt reactors (two on each transformer tertiary) would be used to maintain voltage control.

The 230-kV section of the Colstrip Substation is 750 feet by 350 feet located about 2000 feet north of the plant. Power from units 1 and 2 is transmitted at 230-kV by overhead transmission to this section. Units 3 and 4 would deliver power at 500-kV to a 1000-foot by 900-foot switchyard located adjacent to the 230-kV switchyard.

The Broadview Substation would tie in the Colstrip generating station with the existing 230-kV network in the Billings area through two 3-phase 500-kV autotransformers. Seven 500-kV and six 230-kV circuit breakers would be located at the Broadview Substation. The 500-kV section of the substation would operate as a breaker-and-one-half with a transformer bank on each bus. The 230-kV section of the substation would operate as a ring bus. The breaker-and-one-half scheme uses three breakers for each two lines, or a breaker and one-half for each line. Basically, a ring bus is a series of breakers and buses arranged in such a way that faulted lines can be isolated from the substation with minimum disturbance to the substation. There would also be four 500-kV shunt reactors (one on each line), four tertiary connected, switched, shunt reactors (two on each transformer tertiary), and two banks of series capacitors. Completing the structures at the Broadview Substation is an existing control and relay building 55' x 50' x 14' high.

Broadview Substation is planned as one large fenced area. The 500-kV section would be approximately 550 feet north-to-south by 1600 feet east-to-west. The 230 and 100-kV area would be an irregular fenced area with the maximum each-to-west dimension being 600 feet and maximum north-to-south dimension being 640 feet. The 230-kV portion is complete. The access road has been constructed.

The existing Bonneville Power Substation at Hot Springs would be the contact point for transfer of power to the BPA transmission system. Three 500-kV circuit breakers would be added to the existing breaker-and-one-half substation. Two 500-kV shunt reactors (one on each line) would be added for voltage control.

Proposed Sites and Facilities

The Helena Substation in the Applicant's proposal would provide a switching and sectionalizing point for system stability during certain fault conditions and for system efficiency, reliability, and safety. A ring of four 500-kV circuit breakers, together with the required system compensation equipment, is planned for this substation. Provisions would be made in the substation layout so that step-down transformers may be located there should a future need develop. The fenced area of the Helena Substation would be approximately 500 feet north-to-south by 1800 feet east-to-west. Access would be by a road connecting with existing roads in the area (WESD/AEA 1973).

It is assumed in this report that development of intermediate substations necessary on the Great Falls and Butte-Anaconda plan-of-service alternatives would be basically the same as required at Helena.

COST*

Applicant's Proposal (Helena Plan-of-Service)

Estimated cost of the proposed transmission line along the Applicant's preferred corridor is $177.8 million (1977) or approximately $237,000 per mile for 750 circuit miles of 500-kV line. An additional $91.5 million is estimated to cover substation construction for a total amount of $268.3 million.

The 750 circuit miles include a single 110-mile, 500-kV circuit paralleling the existing double-circuit 230-kV line (which will later be upgraded to a single-circuit 500-kV line) between Colstrip and Broadview. Two parallel, single-circuit 500-kV lines between Broadview and Hot Springs via Helena (320 miles) comprise the remainder of the total circuit miles.

These costs include material, construction labor and equipment, right-of-way clearing and access roads, engineering, construction management, right-of-way acquisition, owner's overhead and allowance for funds during construction. The cost per mile on moderate terrain requiring a minimum of road construction and right-of-way clearing would be as much as five percent less than these average costs. Cost per mile on mountainous, heavily timbered terrain may be as much as ten percent higher than the average costs.

Construction labor contracts are estimated to represent 34 percent of the transmission line construction cost and 30 percent of substation construction costs. These figures include contractors' equipment and overhead costs in addition to labor costs.

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* Costs in Chapter II are based on per mile averages over Step 1 corridors. Revised costs located in Chapter VI are refined considering terrain and mileages used in the Step 3 Corridor analysis. Step 3 segment cost estimates are shown in Table VI-3.

Great Falls Plan-of-Service

Using the per-mile cost average of $237,000, one 500-kV line between Colstrip and Broadview (110 miles) and two 500-kV lines between Broadview and Hot Springs via Great Falls (348 miles) would cost approximately $191.0 million.

Substation costs are estimated to be comparable to the Helena plan-of-service.

Butte-Anaconda Plan-of-Service

For one 500-kV line between Colstrip and Broadview (110 miles) and two 500-kV lines between Broadview and Hot Springs via Anaconda (335 miles), This alternative would cost approximately $184.9 million based on an average cost of $237,000 per circuit mile.

Substation costs would be comparable to the Helena plan-of-service.

Table II-1 PLAN OF SERVICE COSTS ($x10^6$)

	Applicant's Proposal	Great Falls Plan	Butte-Anaconda Plan
Transmission	$177.8	$191.0	$184.9
Substations	91.5	91.5	91.5
TOTAL	$268.3	$282.5	$276.4

TIME FRAMEWORK

The Colstrip Project would be completed in several major phases. The first phase was complete in 1976 when Colstrip Unit 1 was finished. The project would be completed when Unit 4 is operational and the entire transmission system energized.

A general schedule for the completion of the major phases of the project is summarized in Table II-2, as updated from the Westinghouse Report (WESD/ AEA 1973).

Table II-2 MAJOR PROJECT PHASES

Phase	Completion Date
Unit 1	1976*
Colstrip-Broadview 230-kV D.C. line (500-kV construction)	1976*
Broadview Substation (230-kV)	1976*
Unit 2	1976*
Colstrip-Broadview 500-kV line	1980**
Broadview Substation (500-kV)	1980**
Unit 3	1981**
Hot Springs Substation Terminal (500-kV)	1981**
Intermediate Substation (500-kV)	1981**
Broadview-Hot Springs 500-kV line (No. 1 line)	1981**
Convert Colstrip-Broadview D.C. 230-kV line to 500-kV	1981**
Unit 4	1982**
Broadview-Hot Springs 500-kV line (No. 2 line)	1982**

As of August 24, 1977

D.C. - Double Circuit

* - Phase Complete

** - Tentative Schedule Dependent Upon Approval of Federal EIS

BPA-BUILD ALTERNATIVE

TRANSMISSION LINES

Location Criteria

Present planning calls for BPA to build a double-circuit (D.C.) 500-kV transmission line, making maximum use of existing BPA right-of-way from Hot Springs to Garrison, and locating it along new right-of-way east of Garrison to join with the Applicant's Corridor. Environmental impacts could be minimized to the greatest feasible extent utilizing the most viable engineering methods and technology.

The basis for BPA's construction of a transmission line east of Garrison is a request by Montana Power Company to be connected to the BPA grid system from the vicinity of Helena. Under this alternative, the Applicant would not need to build a transmission line all the way to Hot Springs Substation.

During Step 3 of the transmission environmental analysis process (see Chapter VI), two of six new corridor segments introduced from meetings with Federal land management agencies became feasible possibilities for BPA's integration of Colstrip energy near Helena. After analysis by the TER team, segment P alone and segment O combined with segments D_3 and D_4, were determined to be the most environmentally acceptable alternatives which would satisfy the Applicant's request. Therefore BPA is concentrating its studies on these segments at this time, but the possible use of segment F should not be ruled out.

Design Criteria

In order to provide for future needs, BPA is considering in its design options a line that could have one circuit convertible at some future time from a 500-kV alternating current circuit to a ± 500-kV direct current circuit to increase the capacity of the line if ever required. Conversion of the line to direct current would not necessitate a change of structure types or span length; however, the conductors or their configurations may be different depending on the final optimized design.

East of Garrison, sections of the transmission line may have to be constructed on structures other than double-circuit stacked towers. Studies are underway to investigate this possibility.

Right-of-Way

A double-circuit 500-kV transmission line requires a minimum right-of-way width of 125 feet. For the BPA alternatives, a previously acquired, vacant right-of-way 125 adjacent to the BPA Hot Springs-Anaconda 230-kV transmission line is available and is wide enough to accommodate a double-circuit 500-kV line. Only 0.9 mile of new right-of-way would need to be obtained. At the point the line would depart from the existing line, a new right-of-way of from 125 to 235 feet in width, depending on the structure configuration, would need to be acquired.

Table II-3 shows existing and needed right-of-way for the BPA alternatives as it relates to Figure VI-1.

Table II-3 BPA RIGHT-OF-WAY NEEDS

Links	Paralleling Existing R/W (miles)	New R/W (miles)
L-K-J-I	116.8	0.9
P	-	23.6
D_4-D_3-O	-	79.9

The new right-of-way would be acquired by easement. Land owners would retain the right to use land under the transmission lines, but precautions would be necessary.

Structure Types

Self-supporting, stacked double-circuit towers similar to that shown in Figure II-4 would be used for the BPA build alternative although other configurations may be considered during later design stages. The steel lattice structures would have a base approximately 26 feet square. There would be an average of 4.5 structures per mile, depending upon terrain, which will use 150-160 tons per steel per mile. The BPA portion of the line would also include transposition towers as necessary to achieve optimum line operating performance and minimize inductive influence to adjacent wire communication facilities.

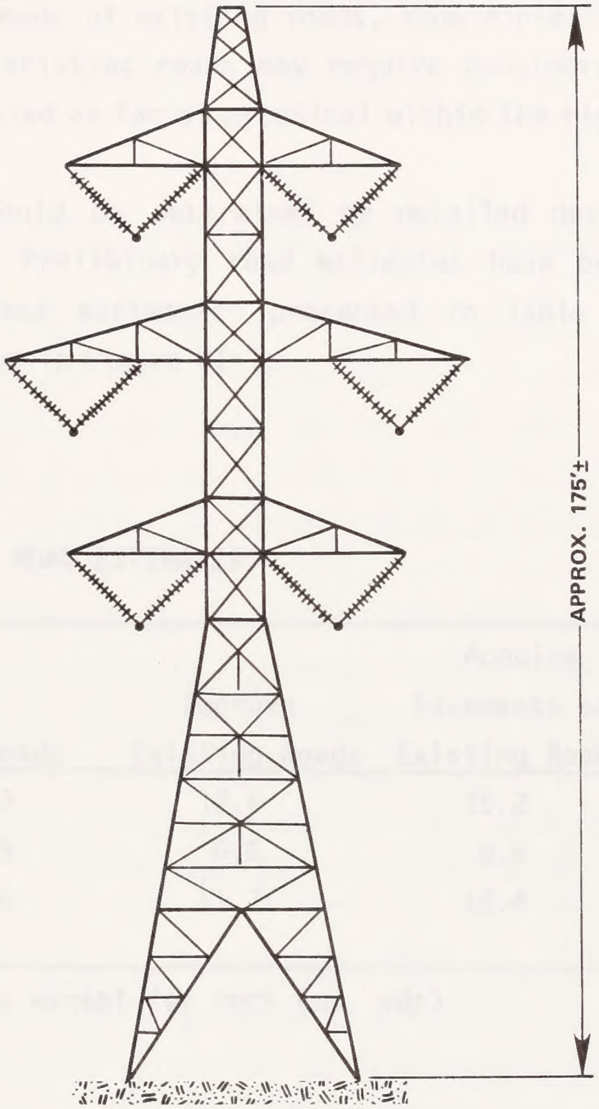
BPA uses several types of footings to support towers, depending upon ground conditions at the structure site. Grillage footings consist of a framework of galvanized steel with wide-flange beams. A pressed plate footing is a galvanized steel plate. All are buried in an excavated pit approximately 10 feet square and deep and tower legs attached to the footing stub extensions. Concrete footings are constructed of reinforced concrete and designed for special conditions. Should counterpoise be required, aluminum wire would be installed. Rock footings consist of stub extensions cemented into a hole blasted into solid rock.

Conductor Types

Currently, "Chukar" conductor (diameter-1.602 inches) is being considered for each circuit. Actual conductor size and configuration would be determined at a later time.

Insulators

A "V" string of standard glass insulators would be used to suspend the conductor bundles from the towers while maintaining electrical isolation between the conductors and the towers.



TYPICAL 500 KV DOUBLE CIRCUIT
STACKED CONFIGURATION TOWER

SCHEMATIC OF BPA TOWER DESIGN
Figure II-4

Support Facilities

Access Roads

Maximum use would be made of existing roads, thus minimizing new construction. However, some existing roads may require considerable improvement. New roads would be located as far as practical within the right-of-way.

Access road length would be determined by detailed design once surveys have been completed. Preliminary road estimates have been made for the BPA alternatives. These estimates, presented in Table II-4, relate to the corridor links shown in Figure VI-1.

Table II-4 BPA ACCESS ROAD ESTIMATES*

Links	New Roads	Improve Existing Roads	Acquire Easements on Existing Roads	Rock
L-K-J-I	10.3	17.6	35.2	15,000
P	15.5	6.6	8.6	10,600
D_4-D_3-O	27.8	11.7	12.4	21,900

*estimates are in miles except for rock (cu. yds)

Staging Areas

Staging areas would be similar to those described for the Applicant's proposal.

Communication and Control Facilities

The communication and control facilities would be the same as those described for the Applicant's proposal.

Construction Sequence

Construction would follow basically the same sequence described for the Applicant's proposal.

Operation and Maintenance Characteristics

Operation and maintenance activities would be similar to those described for Applicant's proposal, except that the full scope of BPA's vegetation management may include the use of herbicides to control tall growing vegetation which could be a hazard to the safe operation of the transmission line, or noxious weeds as required by weed control districts.

The first use of herbicides is on a selective basis in the form of stump treating those species (after cutting) which tend to resprout. The next and continuing use is to control tall growing vegetation on a cyclic basis. Noxious weed control may be required on a fairly regular basis. Appendix B of the Role EIS describes fully the right-of-way management program, including the use of herbicides (BPA 1977b).

The BPA annual program environmental statement identifies specific vegetation management proposals, including those for use of herbicides. The statement is made available to the public and all agencies (Federal, state, etc) for review and comment. Procedures for close coordination of USFS and BPA activities are also identified in the Memorandum of Understanding (dated May 23, 1974; see Appendix F).

Electrical Considerations

Double Circuit Configuration

Audible Noise - Audible noise during ordinary weather conditions, about 96 percent of the time, would be near ambient at 30-40 dBA. During foul weather the average hourly noise level (L50) for the worst case design would be about 57 dBA at a distance of 62.5 feet from centerline (approximate edge of double-circuit right-of-way). This level meets EPA guidelines for noise in a 24-hour period.

Radio and Television Interference - There would be no television interference effects during ordinary weather conditions. During foul weather, television interference due to rainfall would be about 29 microvolts per meter, at a distance of 62.5 feet from centerline (approximate edge of right-of-way) for a frequency of 75 megahertz. During fair weather, the average level of radio interference (L50) would be about 550 microvolts per meter. The average level of radio interference (L50) during foul weather would be about 3,890 microvolts per meter. These values correspond to a distance of 62.5 feet from centerline (approximate edge of right-of-way), at a frequency of 0.834 megahertz.

Ozone - Ozone concentration during foul weather would be about 0.00] pphm at a rainfall rate of 0.25 inches per hour and at a distance of 62.5 feet from centerline (approximate edge of right-of-way). Ozone produced by corona on transmission lines is difficult to measure due to small amounts produced, their rapid dispersal, and ambient levels that vary widely.

Electrostatic and Electromagnetic Field Effects - Shrubs, trees, fences, distribution lines, or other objects that normally stand on or near the right-of-way, reduce the strength of the ground gradient. For the conductor configurations being considered, the ground gradient would not exceed 6.4-kV per meter, which would occur at a point 20 feet from centerline near midspan. At 62.5 feet from centerline the ground gradient would be about 1.8-kV per meter.

Two Single Circuit Configuration - Values for the two single circuit configurations were calculated for the distance of 62.5 feet from centerline. These are essentially the same as those listed above for the double circuit configuration.

SUBSTATION CONSIDERATIONS

The general discussion on substations on the Applicant's proposal would also apply to the BPA-Build alternatives.

The intermediate substation for the BPA-Build alternatives would be a major 500/230-kV substation near Garrison, Montana (Garrison Substation) where BPA's Hot Springs-Anaconda 230-kV line and MPC's Ovando-Anaconda 230-kV lines cross. These lines would be looped into the new station, thereby reinforcing both BPA's and MPC's 230-kV system in the area.

The 500-kV switchyard would provide switching and control facilities for four 500-kV lines, shunt reactor, a 900-1200 MVA autotransformer and possibly series compensation. The 230-kV switchyard would provide switching facilities for the transformer bank, both BPA's and MPC's existing 230-kV lines, and a bus tie.

Ultimate development of the substation, compensation and line corridor would require about 80 acres of land.

The primary reason for new station would be to provide sectionalizing in case of line faults or routine maintenance line sections without loss of generation, provide adequate and proper compensation for power transfer, voltage control and stability; reinforce 230-kV systems; and provide control and communication facilities. The proposed Garrison substation would eliminate the need for the Applicant's proposed substation in the Helena and Anaconda-Butte plans-of-service. The BPA-Build alternative is not applicable to the Great Falls plan-of-service alternative.

At BPA's existing Hot Spring's substation, additional switching and control facilities for two 500-kV lines with shunt reactors would be required. No further expansion is anticipated at this time.

Vegetation control at BPA substations and communications facilities might include the use of herbicides.

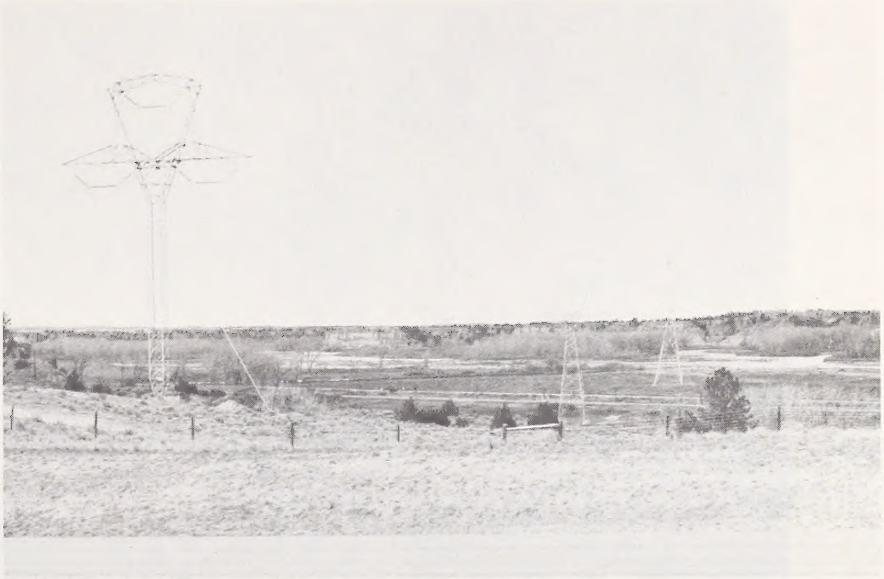
COST

Estimated costs for transmission line construction are shown in Table II-5 for Step 3-level segments. These estimates are preliminary and could change.

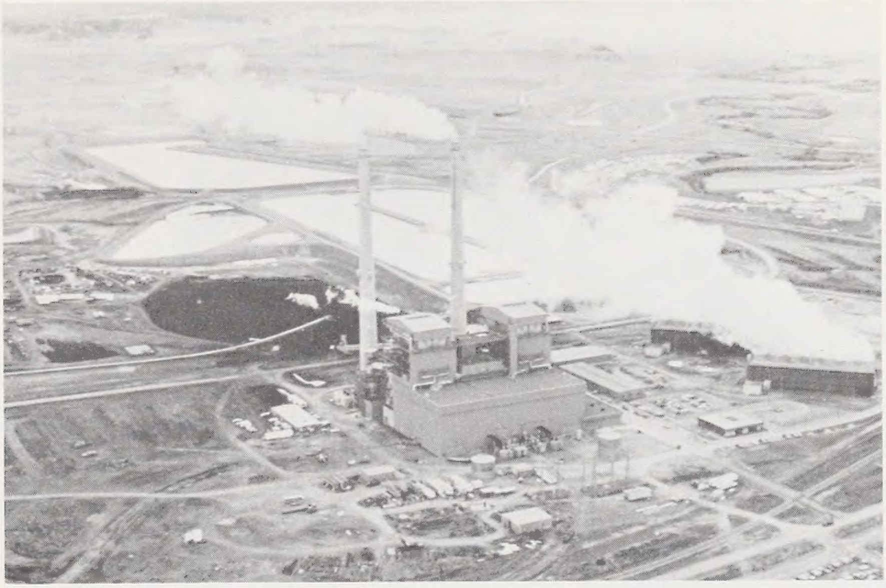
Table II-5 BPA COST ESTIMATES

Garrison-Hot Springs (Segments L-K-J-I)	Avon Valley-Garrison (Segment P)	Townsend-Garrison (Segments D_4-D_3-O)
$67.6 million (117.7 miles)	$14.5 million (23.6 miles)	$47.5 million (79.9 miles)

These costs include material, construction labor and equipment, right-of-way clearing, access roads, engineering, management, right-of-way acquisition and overhead. Costs are not official estimates, only preliminary values based on average per mile costs and best information available at this time.

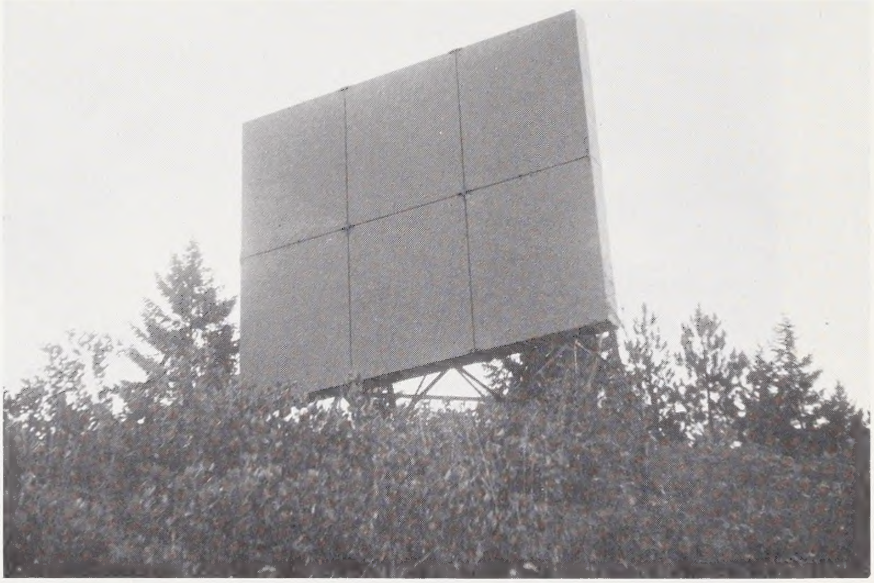


Colstrip to Broadview 230 kV line at its crossing of Interstate Highway 94 showing guyed and self-supporting towers (BLM photo).



Aerial view of the Colstrip power generation plant (BLM photo).

Typical active microwave repeater station (Montana Power Co. photo).



Front view of a typical passive microwave repeater station (BPA photo).

Typical terminal microwave station installation at a substation (BPA photo).

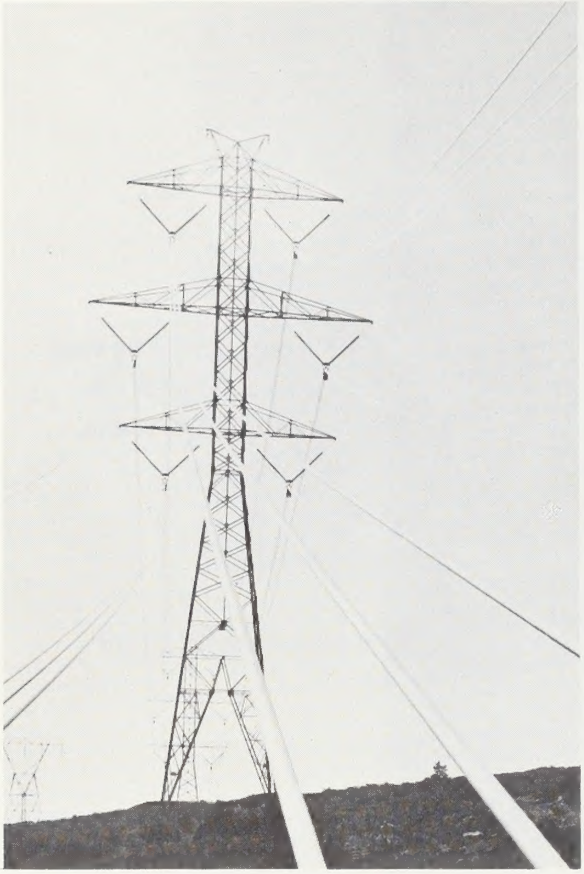
Typical clearing operations (BPA photo).

Typical clearing operations (BPA photo).

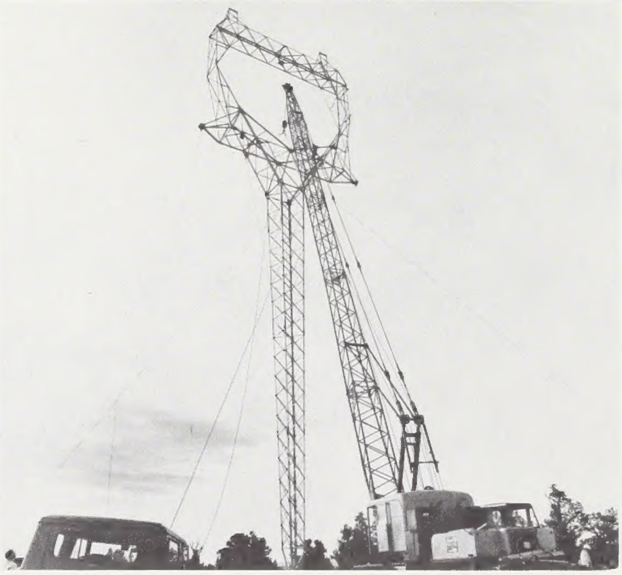
Concrete tower footing poured by helicopter near Lewiston, Idaho (BPA photo).

Helicopter carrying sock line on Dworshak line near Lewiston, Idaho (BPA photo).

Hydroseeding operation on transmission right-of-way (BPA photo).



Typical 500 kV double circuit stacked configuration tower (BPA photo).



Typical tower erection on guyed structure (BPA photo).

DESCRIPTION OF THE EXISTING ENVIRONMENT

DESCRIPTION OF THE EXISTING ENVIRONMENT

STUDY AREA PARAMETERS AND GEOGRAPHY

CRITERIA FOR STUDY AREA BOUNDARIES

The study area boundaries for the Federal Colstrip Transmission Corridor Study Project were established after all the corridors to be analyzed had been mapped. These included the corridors generated by the Applicant (WESD/AEA 1973) and by the State of Montana (DNRC/DEIS 1974). These corridors are shown in Figure IV-1. The study area boundaries correspond to county lines wherever possible. Township and range lines were used where county lines were not feasible. In some cases, visual influence zones extended beyond the study area boundary, however, visual impacts on these areas were analyzed also.

GENERAL GEOGRAPHY OF STUDY AREA

The study area encompasses all or parts of 25 counties within approximately a 36,000 square mile portion of Montana (Figure III-1). The study area is crossed by Interstate Highways 90 and 94 running east-west, and Interstate Highway 15 running north-south. In addition, there are numerous state, county, and private roads. The Interstate highways are located near the major population centers. Listed in order of diminishing population; these are: Billings, Great Falls, Missoula, Butte, Helena, and Bozeman.

The area can be divided into two principal parts based on physiographic boundaries: the eastern or plains portion and the western or mountains portion (see Figure III-2). Elevations in the study area range from over 10,000 feet in the mountains west of Deer Lodge to around 2,500 feet along the eastern margins of the study area.

The eastern part of the study area begins just east of Colstrip and extends approximately 170 miles west to about the Crazy and Little Belt mountains. Land ownership in this area is predominately private, although sizeable acreages of Federal land are administered by the U.S. Forest Service and Bureau of Land Management (Figure III-1). The northern boundaries of both the Crow and Northern Cheyenne Indian Reservations are in the study area. Special use areas include the Lake Mason, Halfbreed and Hailstone National Wildlife refuges.

The western section of the study area extends from the Crazy and Little Belt Mountains west approximately 260 miles to the rugged mountains west of the Thompson River. Much of the land in this area is under Federal stewardship and is administered by the U.S. Forest Service, Bureau of Land Management or Bureau of Indian Affairs. Private ownership of land occurs locally. Special use areas include: the National Bison Range; Pablo and Ninepipe National Wildlife refuges; the Mission Mountain Range, the Gates of the Mountains, Bob Marshall and Scapegoat Wildernesses; and the Lubrecht Experimental Forest.

CLIMATE AND AIR QUALITY

CLIMATIC CHARACTERISTICS

The climate of the study area is influenced by the Continental Divide which traverses the area in a north-south direction. West of the Divide is a modified marine climate, whereas to the east, climatic characteristics are continental. West of the mountain barrier, winters are milder, precipitation is more evenly distributed throughout the year, summers are generally cooler, and winds are less severe than on the eastern side. There is more cloudiness in the west in all seasons, humidity is a bit higher, and the growing season is shorter than in the eastern plains areas.

Tables III-1-A to III-1-F summarize temperature and precipitation characteristics of selected sites in the study area.

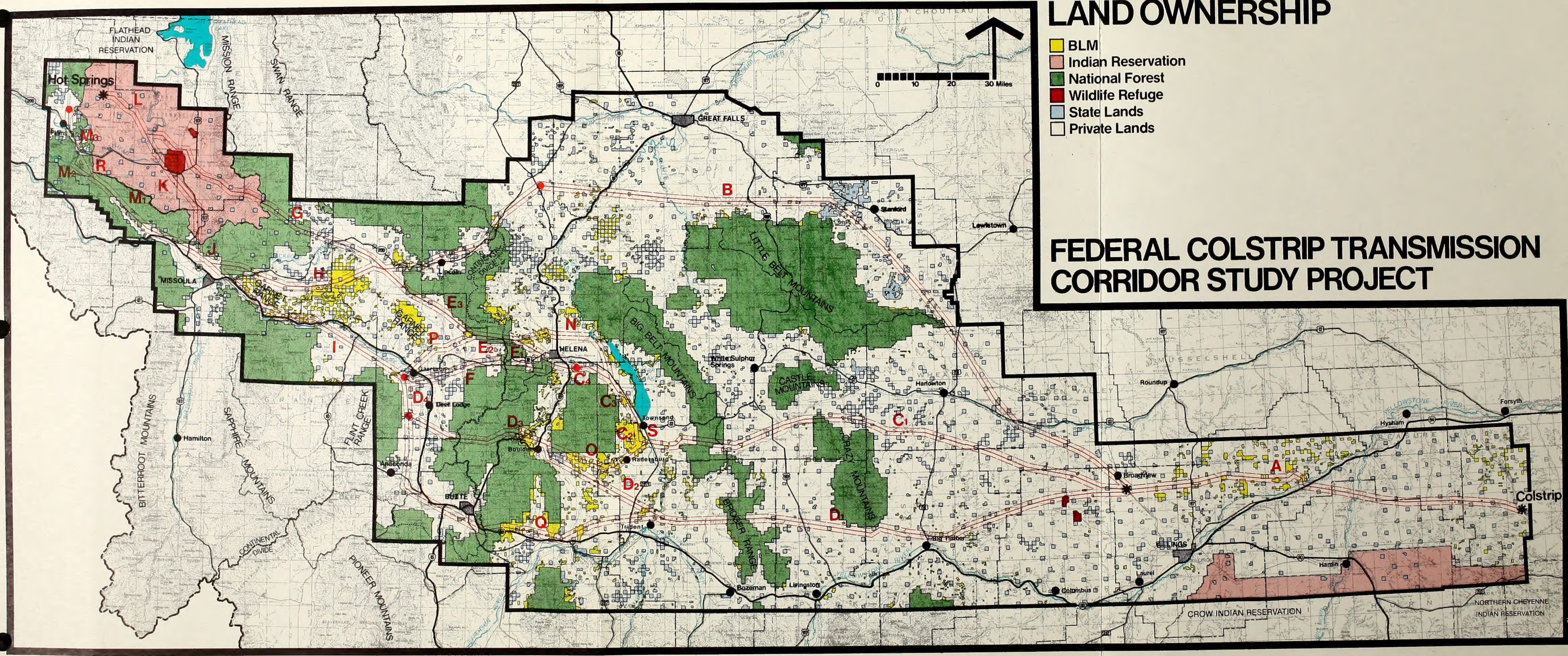
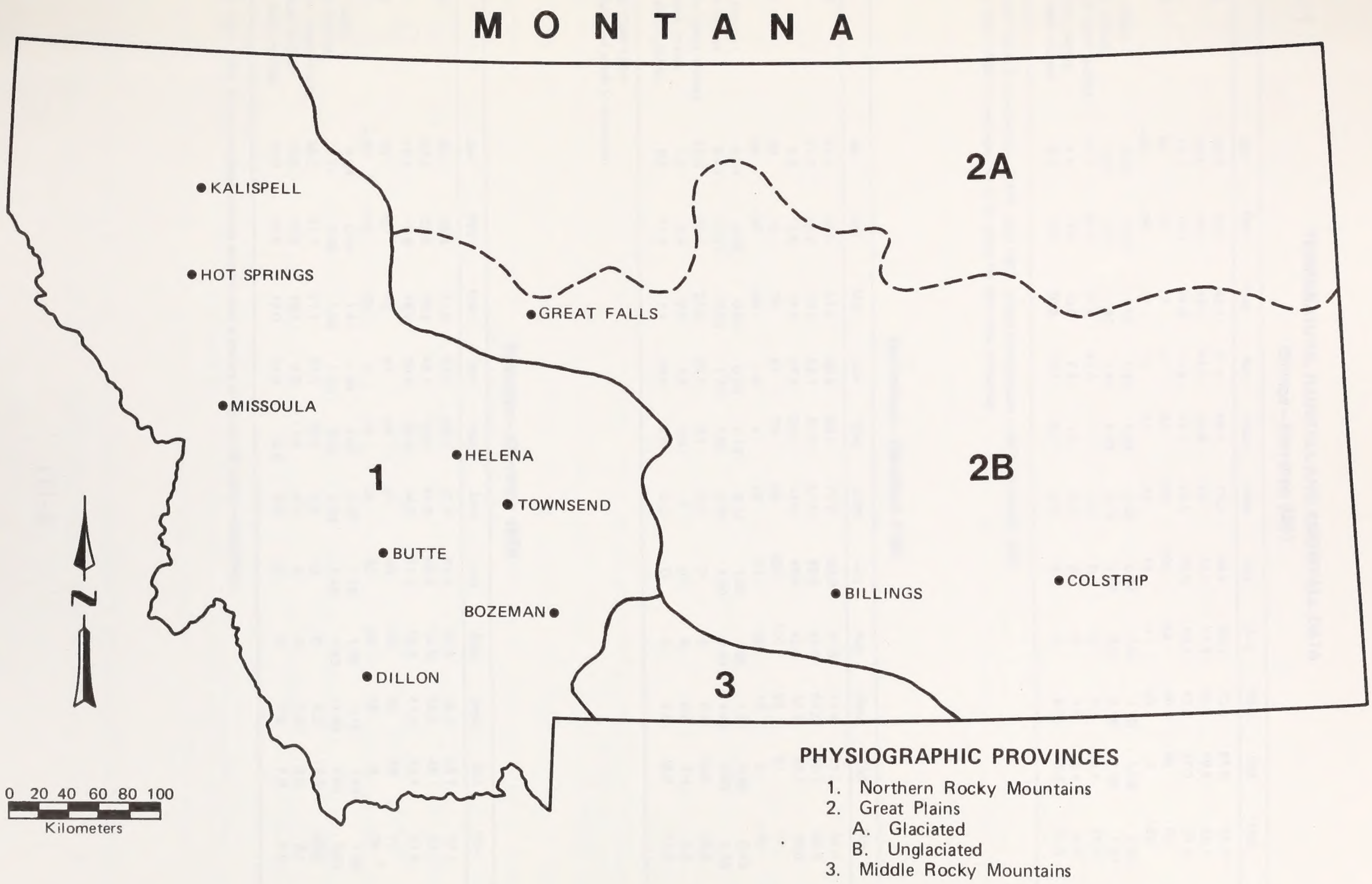

LAND OWNERSHIP
🟨 BLM
▨ Indian Reservation
🟩 National Forest
🟥 Wildlife Refuge
🟦 State Lands
☐ Private Lands
0 10 20 30 Miles
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
FLATHEAD INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
Hot Springs
Plains
L
M3
R
M2
K
M1
G
J
H
MISSOULA
GARNET RANGE
I
E3
P
E2
E1
F
D4
Garrison
Deer Lodge
Lincoln
CONTINENTAL DIVIDE
GREAT FALLS
B
Stanford
Lewistown
LITTLE BELT MOUNTAINS
BIG BELT MOUNTAINS
N
HELENA
C4
C3
C2
S
Townsend
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
C1
Roundup
MUSSELSHELL
Forsyth
Hysham
YELLOWSTONE RIVER
D3
Boulder
O
Radersburg
D2
Anaconda
BUTTE
Q
Trident
BRIDGER RANGE
CRAZY MOUNTAINS
D1
Big Timber
Bozeman
Livingston
Columbus
Laurel
BILLINGS
Broadview
A
Hardin
Colstrip
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
BITTERROOT MOUNTAINS
Hamilton
SAPPHIRE MOUNTAINS
FLINT CREEK RANGE
PIONEER MOUNTAINS
CHOUTEAU
FERGUS

Figure III-1



SOURCE: Fenneman 1931

Figure III-2

Table III-1

TEMPERATURE, RAINFALL AND SNOWFALL DATA

Billings — Elevation 3567

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	33.2	36.0	43.4	57.4	68.1	76.0	88.5	85.2	73.5	61.6	45.0	38.6	58.9
Average, °F	23.2	25.7	33.7	46.0	56.8	65.1	74.7	71.9	60.4	49.5	35.1	28.4	47.5
Average min, °F	13.1	15.3	24.0	34.6	45.4	54.1	60.8	58.6	47.3	37.3	25.2	18.2	36.2
Extreme high, °F	63	72	77	87	94	102	105	105	96	90	72	62	—
Extreme low, °F	−26	−20	−17	13	21	32	43	41	26	3	−22	−26	—
Average rainfall, inches	0.54	0.60	1.05	1.31	1.88	2.55	0.90	0.90	1.19	1.09	0.63	0.59	13.23
Max 24 hr rainfall, inches	0.84	0.61	−.97	2.48	2.83	2.78	1.87	2.47	2.19	1.98	1.37	0.71	—
Max monthly snow, sleet, inches	27.7	22.3	27.6	42.3	7.7	2.0	0	0	6.3	23.1	21.9	28.8	—
Average snow, sleet, inches	8.4	8.5	10.0	7.8	1.2	0.1	0	0	1.0	3.1	6.3	8.2	54.6
Max 24 hr snow, sleet, inches	9.7	9.0	10.5	23.7	5.7	2.0	0	0	6.3	10.0	15.3	13.0	—

Extremes of Record: Highest temperature 112°F, July 1901; lowest temperature −49°F, February 1899.
Period of Record: 1931-1960 for average; 13 to 37 years for recorded extremes.

Harlowton — Elevation 4160

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	33.6	38.0	43.4	56.5	66.4	72.2	83.3	81.8	71.4	61.5	45.6	38.3	57.7
Average, °F	21.7	25.5	30.2	42.1	51.3	57.6	66.0	63.6	54.5	46.1	32.8	26.7	43.2
Average min, °F	9.8	12.9	17.0	27.7	36.2	43.0	48.6	45.3	37.5	30.7	20.0	15.0	28.6
Extreme high, °F	63	74	76	87	93	95	102	101	97	91	78	69	—
Extreme low, °F	−38	−39	−30	−8	4	24	33	29	10	5	−29	−39	—
Average rainfall, inches	0.34	0.33	0.50	0.78	2.13	3.12	1.40	1.06	1.21	0.88	0.45	0.41	12.61
Max 24 hr rainfall, inches	0.46	0.97	0.68	1.70	1.55	2.10	1.30	0.94	1.43	2.02	0.78	0.90	—
Max monthly snow, sleet, inches	16.8	20.2	21.5	24.0	9.7	2.0	0	0	7.8	19.0	16.0	25.6	—
Average snow, sleet, inches	5.3	5.5	6.5	4.8	0.6	T	0	0	0.6	2.4	5.3	6.6	37.6
Max 24 hr snow, sleet, inches	9.4	11.4	7.4	24.0	4.0	2.0	0	0	4.0	16.0	11.0	16.2	—

Period of Record: 1936-1966
T =trace, an amount too small to measure.

Bozeman — Elevation 4856

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	30.7	35.3	41.0	53.7	63.3	70.2	81.5	80.3	69.5	58.7	42.4	34.9	55.2
Average, °F	20.4	25.9	30.2	42.1	50.9	57.6	66.3	64.9	55.6	46.1	32.2	25.2	43.1
Average min, °F	10.1	15.8	19.2	30.4	38.5	44.9	51.1	49.4	41.5	33.4	21.9	15.5	30.0
Extreme high, °F	58	62	70	81	89	91	98	99	95	82	70	59	—
Extreme low, °F	−36	−29	−23	2	16	26	32	29	16	9	26	−29	—
Average rainfall, inches	0.94	0.68	1.41	1.84	2.61	3.27	1.19	1.36	1.76	1.44	1.26	0.86	18.61
Max 24 hr rainfall, inches	0.77	0.88	1.04	1.53	2.06	2.08	1.45	1.33	1.69	1.07	0.91	0.88	—
Max monthly snow, sleet, inches	32.0	21.1	41.7	37.0	15.0	6.0	0	0	7.0	18.9	25.5	26.0	—
Average snow, sleet, inches	13.8	10.9	16.3	5.9	1.2	0.4	0	0	1.0	3.0	8.1	12.5	73.1
Max 24 hr snow, sleet, inches	10.0	10.0	12.0	14.0	15.0	6.0	0	0	7.0	7.0	8.0	10.5	—

Period of Record: 1931-1960. Snow and sleet records extend over a period of 16 and 28 years, respectively.

Table III-1 (cont.)

TEMPERATURE, RAINFALL AND SNOWFALL DATA

Great Falls—Elevation 3662

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	31.6	34.0	41.1	55.2	65.7	72.9	84.7	81.8	71.2	59.3	44.2	35.8	56.5
Average, °F	22.1	23.8	30.7	43.6	53.0	59.9	69.4	66.8	57.4	47.5	34.3	27.3	44.7
Average min, °F	12.5	13.6	20.2	31.9	40.2	46.9	54.1	51.8	43.5	35.6	24.4	18.8	32.8
Extreme high, °F	61	64	72	83	89	97	100	106	98	85	72	61	—
Extreme low, °F	−37	−22	−19	5	19	32	41	37	23	0	−15	−43	—
Average rainfall, inches	0.61	0.74	0.92	0.98	2.10	2.90	1.28	1.26	1.20	0.73	0.75	0.60	14.07
Max 24 hr rainfall, inches	0.74	0.88	1.01	2.43	3.20	2.74	1.40	1.72	1.70	1.15	0.97	0.69	—
Max monthly snow, sleet, inches	22.6	26.1	21.3	35.4	8.1	11.1	T	0	7.7	14.2	22.1	25.0	—
Average snow, sleet, inches	9.7	9.0	9.6	6.4	1.4	0.5	T	0	1.3	2.5	7.5	8.3	56.2
Max 24 hr snow, sleet, inches	9.6	11.0	10.0	9.2	6.2	11.0	T	0	6.1	8.3	10.8	9.8	—

Extremes of Record: Highest temperature 107°F, July 1933; lowest temperature −49° F, February 1936.
Period of Record: 1931-1960; extreme temperatures 11 years; precipitation and snow 34 years.
T = trace, an amount too small to measure.

Helena—Elevation 3828

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	28.8	33.7	42.5	56.1	65.8	72.3	84.4	82.2	70.8	58.8	42.4	34.2	56.0
Average, °F	18.6	23.2	31.4	43.3	52.9	59.5	68.4	66.2	56.0	45.6	31.6	24.2	43.4
Average min, °F	8.4	12.7	20.2	30.5	39.9	46.6	52.3	50.1	41.2	32.3	20.8	14.2	30.8
Extreme high, °F	55	61	74	81	90	93	99	105	99	85	67	59	105
Extreme low, °F	−35	−11	−16	11	23	30	40	39	18	15	−6	−38	—
Average rainfall, inches	0.47	0.43	0.7	0.83	1.56	2.23	1.03	0.89	0.95	0.66	0.57	0.53	10.82
Max 24 hr rainfall, inches	0.77	0.58	1.01	1.25	2.06	1.70	1.50	0.98	1.42	0.85	0.82	0.46	—
Max monthly snow, sleet, inches	35.6	19.6	21.6	20.6	12.7	2.7	0	0	13.7	11.0	32.9	22.8	—
Average snow, sleet, inches	9.0	6.3	7.5	5.1	1.8	0.2	0	0	1.6	1.7	7.0	8.9	49.1
Max 24 hr snow, sleet, inches	11.5	8.6	8.7	12.9	12.5	2.7	0	0	13.3	7.4	21.5	10.7	—

Extremes of Record: Lowest temperature −42°F.
Period of Record: 1931-1960.

Missoula—Elevation 3190

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Average max °F	28.0	34.0	43.8	57.1	66.6	72.8	85.0	82.7	71.5	57.5	39.9	31.6	55.9
Average, °F	19.2	25.0	33.7	44.3	52.6	58.5	67.0	64.8	55.4	44.0	30.5	23.5	43.2
Average min, °F	10.3	15.9	23.6	31.4	38.5	44.2	49.0	46.9	39.2	30.4	21.3	15.4	30.5
Extreme high, °F	52	60	70	83	91	97	105	105	99	85	65	57	—
Extreme low, °F	−27	−10	−9	16	22	31	31	32	20	0	−8	−30	—
Average rainfall, inches	0.92	0.87	0.73	0.97	1.87	1.91	0.85	0.72	1.02	−.99	0.90	1.08	12.83
Max 24 hr rainfall, inches	0.88	0.76	0.44	1.65	1.82	1.61	1.47	1.43	1.34	1.49	0.60	0.94	—
Max monthly snow, sleet, inches	42.5	18.6	13.4	8.2	7.5	T	0	0	0.2	4.6	17.7	31.6	—
Average snow, sleet, inches	13.5	7.7	6.3	2.7	1.0	T	0	0	T	0.6	6.1	11.5	49.4
Max 24 hr snow, sleet, inches	11.2	9.7	6.5	6.9	6.5	T	0	0	0.2	2.0	6.2	9.6	—

Extremes of Record: Lowest temperature −33° F, January 1957.
Period of Record: 1931-1960; extreme temperatures 12 years of record; precipitation 27 years of record.
T =trace, an amount too small to measure.

Source: WESD/AEA 1973, Table 3.4-3

Temperature

Cold waves cover parts of Montana on the average of 6 to 12 times a winter and are confined mainly northeast of a line between Glacier Park and Miles City. A few of these cold waves cover the entire state. In small areas ideally situated for radiation cooling, low temperatures can fall to -50° F or lower. The coldest temperature on record is -70° F at Rogers Pass, 40 miles northwest of Helena, on January 20, 1954. This is also the coldest recorded temperature for the entire Continental United States.

During the summer months, hot weather often occurs in the eastern parts of the state. Temperatures over 110° F have been recorded near Colstrip. In the lower elevation areas west of the Divide, temperatures of over 100° F sometimes occur during the summer, but hot spells are less frequent and of shorter duration than in the plains section. Summer nights almost invariably are cool and pleasant. Above 4,000 feet, extremely hot weather is almost unknown. Summer days, however, are usually warm enough for light summer clothing.

Winters, while usually cold, have few extended cold spells. Between cold waves there are periods, sometimes longer than 10 days, of mild but often windy weather. These warm, windy winter periods occur almost entirely along the eastern slopes of the Divide and are popularly known as "chinook" weather. The so-called "chinook" belt extends from the Browning-Shelby area southeastward to the Yellowstone Valley above Billings. Through this belt, "chinook" winds frequently reach speeds of 25 to 50 mph or more and can persist, with little interruption, for several days. In January, the coldest month, recorded temperature averages in the study area range from 15° F at Ovando, northeast of Missoula, to 30° F at Whitehall, northwest of Bozeman. In some areas east of the Continental Divide, January or February temperatures can average zero or below, but such occurrences are infrequent.

In July, the warmest month, recorded temperature averages in the study area range from 73° F at Ballantine northeast of Billings, to 66° F at

East Anaconda. This mid-summer warmth is fairly steady, very seldom severe, and is tempered by normal nighttime minima in the 50s and 60s.

Precipitation

Precipitation varies widely and depends largely upon topographic influences. Areas adjacent to mountain ranges are generally the wettest, although there are a few exceptions where the "rain-shadow" effect appears. Generally, nearly half the annual long-term average total falls from May through July. The western portion of the study area is the wettest and the central the driest. There are a few relatively dry western valleys as reflected by averages for Deer Lodge and Lonepine of 11.00 and 11.5 inches, respectively. Probably the driest part of the study area is near Helena in Lewis and Clark County. In this area, the average precipitation is 10.2 inches. The highest average is 22.5 inches at Thompson Falls just west of the study area.

Annual snowfall varies from quite heavy--200 inches in some parts of the mountains in the western half of the state--to about 36 inches at some stations in the northeast portion of the study area. Most of the larger cities have annual snowfall within the 30 to 50-inch range. Most snow falls during the November-March period, but heavy snowstorms can occur as early as mid-September or as late as May 1, at the higher elevations. In the eastern section, early or late season snows are relatively uncommon. Mountain snowpacks in the wetter areas often exceed 100 inches in depth by the end of the annual snow season (April 1 to 15).

Other Climatic Features

Severe storms of several types can occur, but the most troublesome are hailstorms which cause crop and property damage averaging about $5 million annually. They occur mainly in July and August, and infrequently in June and September.

Tornadoes develop infrequently (about 2 per year) and occur almost entirely east of the Divide, largely in the eastern portion of the study area. Severe windstorms of a general nature are rare but can occur locally, mainly east of the Divide, from a few to several times a year. Drought in its most severe form is practically unknown, but dry years do occur in some sections. Rarely do all parts of the state suffer from dryness at the same time. The only exceptions on record occurred during the 1930s. Droughts lasting 2 or 3 years occur infrequently in one or two of the state's climatic subdivisions.

In spite of figures that may indicate winters are cold, freeze-free periods are 4 or more months long in many of the lower valleys. In parts of the middle Yellowstone Valley, in fact, the freeze-free period may equal the 155-day average at Billings. Much of the state has average freeze-free periods longer than 130 days. There is no freeze-free period in many higher valleys of the western mountains.

Climatic features most significant to transmission line corridor selection are those relating to line reliability, such as lightning incidence, icing zones, and tornadoes or other severe wind frequencies. Although detailed data of this type do not exist for the study area, some generalizations can be made. The potential for lightning strikes is greatest along the Continental Divide and decreases both to the east and west. Locally, mountain passes may have strong gusty winds caused by local topography, but wind speed averages are not a major corridor location factor.

The major climatic restrictions upon transmission line construction are adverse winter conditions and short snow free periods in the mountains. Snow may occur as early as mid September or as late as May, and remain on the ground until June or July.

AIR QUALITY

The Clean Air Act of Montana, relating to air pollution, was enacted in 1947. Revisions to this act, effective as of July 1, 1975, are detailed by the Montana Department of Health and Environmental Sciences (MDHES, 1975). Under this act, the State has been divided into five Air Quality Control Regions, each of which is partially overlapped by the study area.

Both the Federal and Montana ambient air quality standards for sulfer dioxide and the Federal secondary standard for particulates have been exceeded at times in certain locations of the study area. Measurements taken in the Billings area between 1974 and 1976 indicate little change in average annual concentrations but a trend toward increased maximum 24-hour readings. Ambient particulate standards have been exceeded frequently in the Butte area, and sulfer dioxide standards exceeded in the Helena and Anaconda areas. Smelter and refinery industries are major sources of these pollutants (MDHES, 1977).

Other major sources of air pollution in western Montana are the tepee burners of numerous sawmills. Emissions from these are mainly particulates, hydrocarbons, and carbon monoxide. Some point sources also include nitrogen oxides and flourides. In rural areas, air quality measurements indicate generally high air quality throughout the year (MDHES, 1977). Dust particulates from wind erosion on agricultural lands can be serious at times. Air quality maintenance plans are either currently in effect or being developed for all major urban areas of the state where industries are located.

GEOLOGY AND MINERAL RESOURCES

Because of the extensive work done for the Westinghouse Report (WESD/AEA 1973) and the State of Montana environmental analysis (DNRC/DEIS 1974), this section was compiled directly from these two reports as a summary. For a more complete description of the topics in this section, reference to these reports is recommended.

GEOLOGIC SUMMARY

General Data

Geologically, Montana is very complex. Its formations range in age from Precambrian (more than 600 million years in age) to Recent and include all three geological rock classifications: igneous, metamorphic and sedimentary. Montana was submerged under vast seas that regressed during mountain-building periods and advanced when mountains began eroding away.

The eastern area is covered by younger formations, primarily the Fort Union formation. The ground surface of the central area consists of older, Cretaceous sediments and rocks of the Paleozoic era. In the mountainous western area of Montana, rocks of the Precambrian era are exposed.

The geologic structures of Montana and of the transmission line study area show a close relationship to the designated physiographic divisions discussed earlier (see Figure III-2). In the eastern or plains area, the structures are gentle and the geologic strata are nearly flat-lying; there are relatively few faults, none of which has great displacement. In the central part of the study area, because of the uplift of the isolated mountains, the numerous domes, anticlines and synclines are more severe than eastern structures but less so than structures in the mountainous west. In the western part of the study area, the severe mountain-building pressures that formed the Rocky Mountains and the intrusion of igneous complexes have caused great structural as well as topographic relief.

Bedrock varies significantly in hardness and strength. In general, the argillites, carbonates, igneous rocks, quartzites, and sandstones within the study area are hard and strong, require blasting for excavation, and are capable of supporting lofty cliffs. Shale, however, is soft, weak, and easily excavated or eroded. Rock strength is frequently reduced by the presence of bedding planes and fractures which can significantly affect the location of towers and roads.

Unconsolidated deposits occupy virtually all stream valleys. In the western part of the study area, these deposits are in the form of Tertiary age valley fill, and Quaternary age glacial and alluvial deposits. Elsewhere, valley deposits are mainly recent alluvial. Alluvial gravels of Cenozoic age also occur in broad areas near the Snowy Mountains and in other, smaller patches throughout the plains region. A thin layer of weathered rock debris, or regolith, covers much of the areas where bedrock lies near the surface. Some rocks, notably granite, have very thick soil cover in older, unglaciated terrain. Many steeper hillsides, especially in mountain areas, contain deposits of broken rock that have tumbled down from higher slopes.

Hazards

Soil stability and the possibility of landslides are important considerations in tower siting and access road construction. Most unstable slopes in Montana at angles of less than 30 degrees are found in areas where shale beds are lubricated by water. Stability in component rocks may be weakened by planes of jointing, foliation or steep slopes.

Landslide hazards range from massive rockslides or debris avalanches in the high mountains to slump-earthflows or soil slips in the foothills and plains. The slope movements may be nearly instantaneous (unusual) or slow (more usual). Many slides move over a period of weeks or years rather than minutes (see the Westinghouse Report for a detailed landslide analysis report within the study area).

The five landslide hazard rating classes presented in Figure III-3 are as follows:

Slight - Within areas rated as having a "slight" landslide hazard, there will be a few sites where shales on steep terrain contain enough water that serious hazards exist. A slope stability evaluation of these sites should be made prior to construction.

LAND SLIDE HAZARDS

- 🟨 Slight
- 🟦 Slight to Moderate
- 🟦 Moderate
- 🟥 Moderate to Severe
- 🟩 Severe

Source: WESD/AEA 1973, Figure 3.4.3

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

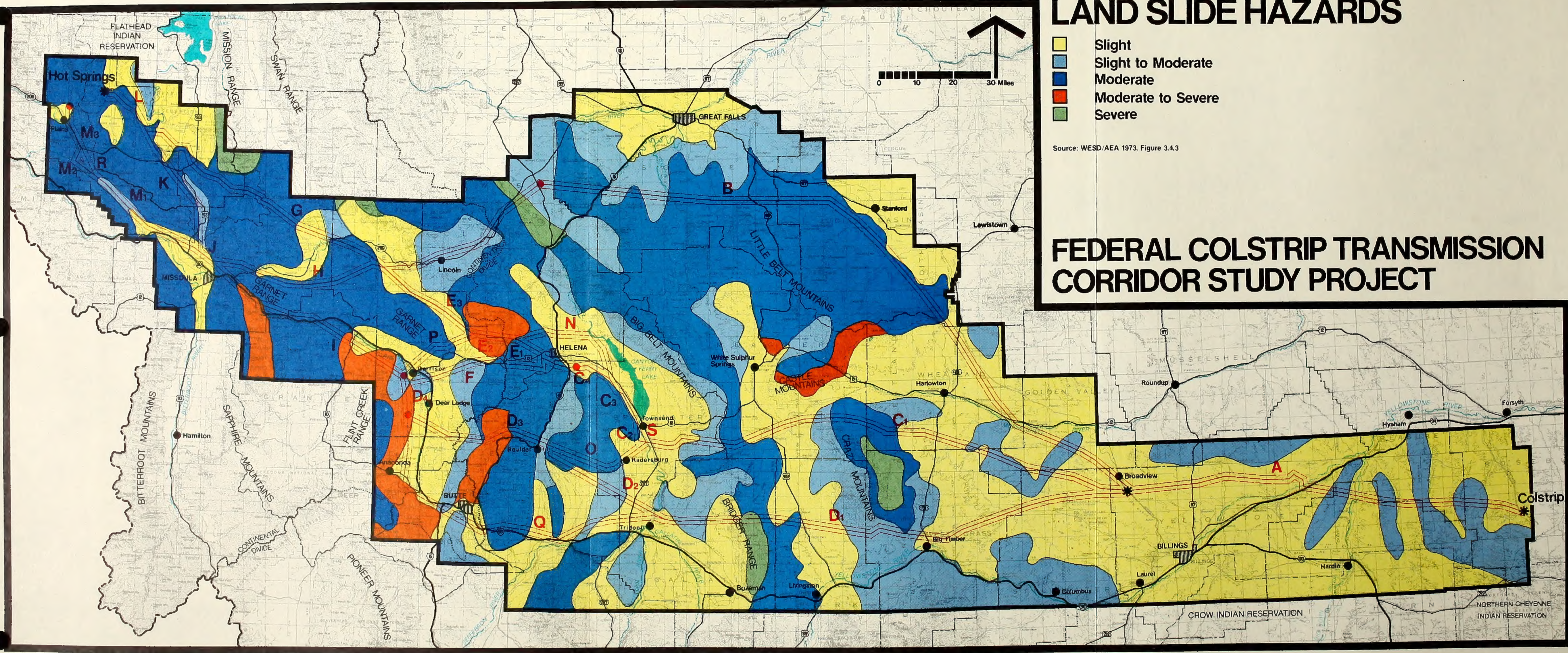


Figure III-3

Slight to Moderate - These are similar to the areas rated "slight" but have steeper terrain. Individual transmission line sites and construction roads should be examined in areas of steep terrain.

Moderate - These are areas of steep terrain where slide-prone geologic formations are prominent. Stability hazard in these areas is high enough to warrant a stability reconnaissance of each tower and road location. Corridors passing through moderate hazard areas may likely encounter unstable areas. However, proper planning and engineering should easily overcome most restrictions.

Moderate-Severe - Stability in these areas would require extensive engineering to relieve hazards along a transmission line corridor.

Severe - Where found, a severe hazard would indicate active slopes where powerline installation would not be advisable. Road building and tree removal could trigger large landslides.

Due to limitations of available information, geologic elements of environmental concern in transmission line construction are frequently difficult to identify. Mass movement hazards, such as landslides, are difficult to foresee, although some areas where these events have occurred in the past may be readily identified. Also, some potential geologic conflict areas are so localized as to be unimportant in selection of a two mile-wide corridor.

Seismicity

Montana lies in the intermountain seismic belt, one of the more active earthquake zones in the United States. Large quakes can disable electrical generating plants by damaging the plant itself or its associated facilities. Although transmission lines are less susceptible to damage from a quake, seismic hazards should be evaluated and considered in the planning of the proposed facilities.

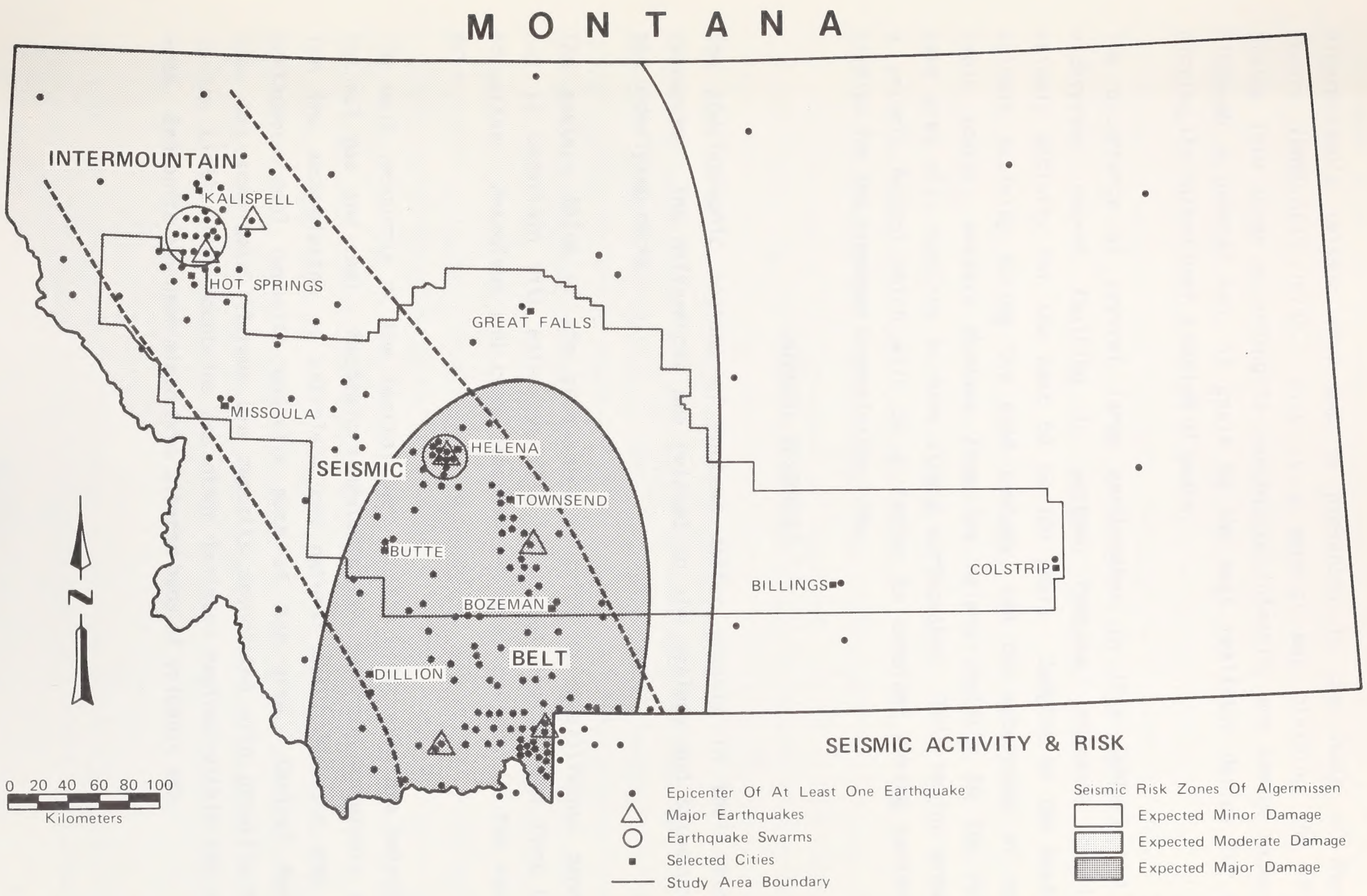
Relative motion of parts of the earth's crust puts stress on the boundaries of these areas. Rock strength and friction prevent continuous motion. The shearing stresses produce an elastic strain which is released along a fault when the stress overcomes the strength of the rock. The energy of the suddenly released strain is converted into movement along the fault and is propagated as seismic waves. An area experiences an earthquake as the seismic waves vibrate the ground in passing.

The Seismological Society of America and the United States Coast and Geodetic Survey have reported earthquakes occurring in Montana since 1902. The area east of central Montana is relatively inactive seismically. The few events that have occurred were of low magnitude.

Most known Montana earthquakes, including all the major ones, have occurred west of the plains in the northern Rocky Mountain area (see Figure III-2). This area is within the intermountain seismic belt (see Figure III-4), a broad zone of earthquake epicenters extending from northwestern Montana through the Helena area, southward through West Yellowstone, southeastern Idaho, and central Utah to southwestern Utah. This zone ranks behind California and Nevada as the most active seismic region in the conterminous United States.

Earthquake hazard evaluation must assess the probability of earthquake occurrence plus local responses to an earthquake. Since quakes trigger landslides and other phenomena, these secondary effects must also be considered. To minimize the chances of earthquake damage to the transmission system, some care must be excercised in determining its location.

The Westinghouse Report (WESD/AEA 1973) presents a statistical approach by Epstein and Lomnitz in evaluating seismic risk. This methodology is based on the premise that for a particular area, seismic events have occurred in the past at certain intervals and presumably will occur at those intervals in the future. The results can serve as guidelines for earthquake frequency and magnitude.



Source: DNRC/DEIS 1974, Vol. 4, Figure 5-18.

Figure III-4

Algermissen's seismic risk map is presented in the State of Montana report (DNRC/DEIS 1974). This is a general map dividing the United States into zones according to earthquake intensity and damage expected. Although a general map, it could be the most realistic device for predicting the hazard over a period of years.

The occurrence of several large earthquakes in this century and the widespread recent faulting in western Montana indicates continued seismic activity for the next 50 to 100 years. Judging on the basis of seismic activity during the past century, and the occurrence of recent fault scarps, western Montana from the Helena vicinity to the Hebgen Lake area will continue to have strong earthquakes. This region presents a seismic hazard which will be a factor to consider during centerline studies for the proposed transmission line.

MINERAL RESOURCES

The physiographic regions of Montana differ greatly in their mineral resources. The differences are related to the geology and structure of the underlying rocks.

The eastern third of the study area contains no metalliferous deposits but is underlain with extensive flat-lying coal beds in the Fort Union Formation. Petroleum and clay minerals are also present in the eastern area.

The main resources of the central part of the study area are petroleum, natural gas and coal. Mesozoic sandstones are important reservoir rocks for the accumulation of petroleum and natural gas. Jurassic and late Cretaceous coal deposits underlie much of the area. Central Montana also has some metalliferous ore deposits associated with granitic rocks in the Little Belt Mountains and other isolated regions within the study area. Bentonite has been mined from altered beds of volcanic ash.

The metallic ore deposits of the western part of the study area (gold, silver, copper, zinc, lead, antimony and tungsten) are mainly associated with igneous intrusive rocks as well as the host rocks, which are either sedimentary, igneous or metamorphic. The Boulder batholith is the principal contributor within the study area to the great mineral productivity of western Montana. In southwestern Montana, talc, corundum, iron ore, graphite, sillimanite, chromite, and kyanite deposits are found in Precambrian rocks. The sedimentary rocks are sources of phosphate, limestone, silica clays and other industrial minerals.

Mineral resources within the transmission line study area are graphically displayed as mining districts in Figure III-5 (also see Mardirosian 1976). Many of the districts shown in this figure are inactive or barely active, awaiting a rise in metal prices that would make mining more economically feasible. The largest metal mine in Montana is the Berkeley Pit at Butte. Owned by the Anaconda Mining Company, this mine is a major producer of copper and, to a lesser extent, of the precious metals.

The mining industry ranks second in the state of Montana behind agriculture and exceeds cultivated crop income during some years. Montana mineral production for 1970 was valued at $313 million, an increase of 11% over the previous year's value. The year 1970 was strike-free and the mineral industry produced at close to capacity levels.

Approximately 50% of the state mining income is produced within the study area. Silver Bow County (including the Berkeley Pit of the Anaconda Company) produced 80% of the total mining output for the study area during 1969 and 87% during 1970 (WESD/AEA 1973:3-62). The Silver Bow County mining income for 1970 was $146 million compared with $7.5 million for Rosebud County, which had the next highest output within the study area. Throughout much of the study area, sand and gravel are the principal mining products.

SOILS AND TOPOGRAPHY

GENERAL DISCUSSION

As described earlier, the study area for the proposed transmission lines includes parts of two physiographic provinces. The eastern one-third is within the Great Plains Province, and the western two-thirds is within the Northern Rock Mountains Province (Fenneman 1931).

The soils of the Great Plains are primarily well-drained clay loams and loams. They are underlain by sandstone and shale bedrock which is found at depths varying from less than 20 to more than 60 inches. They have slope gradients which normally range from 0 to 25 percent except in the badlands where gradients of up to 60 percent are not uncommon.

The soils of the mountains are distinctly different on the mountain slopes than they are in the intermountain valleys. The soils of the mountain slopes are primarily well-drained loams and silt loams with slope gradients normally ranging from 25 to 70 percent. The depth of the soil (depth to bedrock) ranges from less than 20 to more than 60 inches, and the bedrock type includes a wide variety of igneous, sedimentary, and metamorphic rocks.

The soils of the intermountain valleys are primarily well-drained clay loams and loams with slop gradients normally ranging from 0 to 20 percent. Bedrock is buried deeply beneath thick layers of water deposited material.

DOMINANT SUBORDERS

The dominant soil suborders present in the transmission line study area are boralfs, borolls, fluvents, ochrepts, orthents, orthids, and psamments (USDA Forest Service 1976a, 1972; USDA Soil Conservation Service, et al. 1977, 1972 and 1967).

Boralfs are the forested soils of cool climates which have more clay in the subsoil ("B" horizon) than in the surface layer. The increased clay content of the subsoil is due to soil forming processes (eluviation and illuviation). These soils have water available to plants for at least three months of the growing season. Most of the boralfs in the study area are in mountainous country.

Borolls are the fertile soils of cool climates with a grass vegetation. They have a very dark colored surface layer ("A" horizon). Borolls are found throughout the study area in intermountain basins, mountain foothills and on the plains.

Ochrepts are forested soils that have developed definite soil layers but do not have more clay in the subsoil than in the surface layer. Most of the ochrepts in the study area are in mountainous country.

Orthids are soils which are dry for long periods and which have well developed soil layers. Most of the orthids in the study area have lime at or near the surface and are light colored. They are common in the B_1 mapping unit (see Figure III-6) of the intermountain basins in the vicinity of Helena and Bozeman.

Fluvents, orthents, and psamments are soils which are in an early stage of development. They have not developed the distinct soil layers found in the previously described soil orders. Fluvents are non-sandy soils formed in water deposited sediments on flood plains of rivers and streams. Their development is frequently interrupted by new layers of sediment deposited when the streams flood.

Orthents are non-sandy soils whose development has been retarded by either cold climate, lack of moisture, or rapid erosion which carries the soil away before a distinct profile can develop. Orthents are found throughout the study area, but they are most prevalent in those parts of the plains which receive less than 14 inches of annual precipitation.

Psamments are similar to fluvents and orthents except that psamments have a sandy texture. Psamments and fluvents are found throughout the study area along major streams and rivers.

MINERAL RESOURCES

▥ Coal Deposits
A Great Falls Coal Fields
B Bull Mountains Coal Fields
C Southeastern Montana Coal Fields

■ Coal Mining Areas (approximate locations)

▲ Mining Districts (approximate locations)

Source: adapted from WESD/AEA 1973, Fig. 3.4-4

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

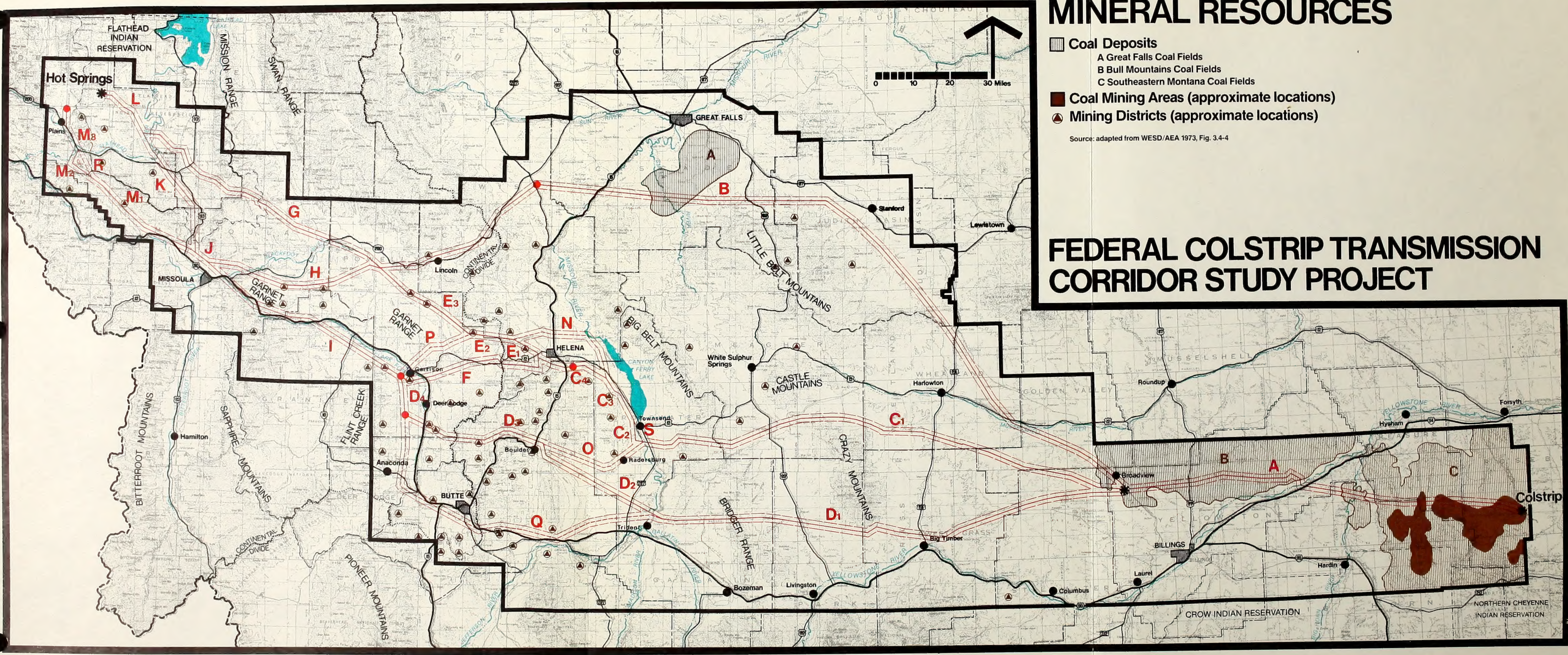


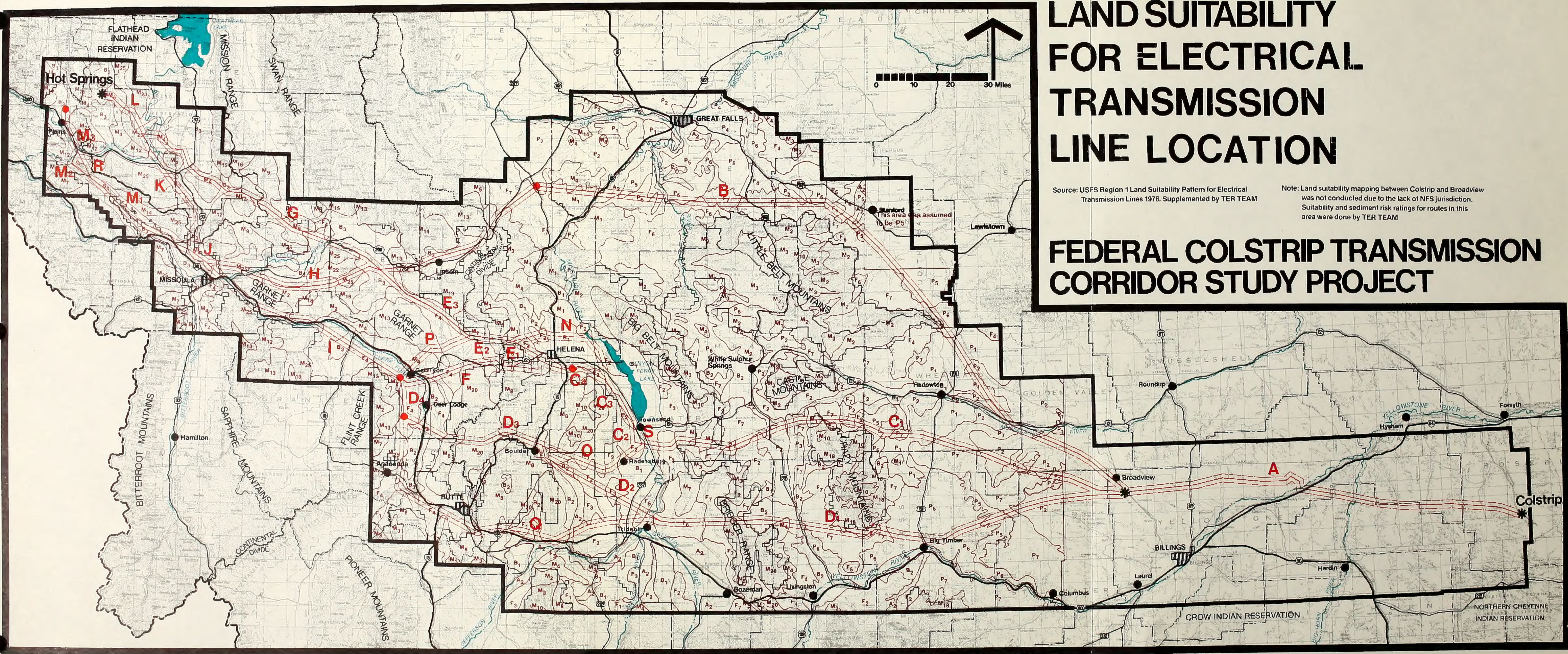
Figure III-5

LEGEND

Figure III-6

MAPPING UNIT	UNIT DESCRIPTION	OVERALL SUITABILITY	WATER EROSION COMPACTED SOILS	SEDIMENT RISK
A_2	Alluvial Floodplains--Grassland	Fair	Low	Low
B_1	Alluvial Basins	Good	Moderate	Low
B_2	Alluvial Basins	Good	Moderate	Low
B_3	Glacial basins--Grassland	Good	Low	Low
B_4	Glacial basins--Forested	Good	Moderate	Low
B_5	Glacial basins--Forested	Good	Low	Low
B_6	Glacial basins--Forested	Good	Low	Low
F_1	Igneous and metamorphic foothills	Fair	Moderate	Moderate
F_2	Folded sedimentary rocks	Fair	Moderate	Moderate
F_3	Gravel capped benches	Good	Moderate	Low
F_4	Gravel capped benches	Good	Moderate	Low
F_5	Hogback ridges, hard sedimentary rocks	Fair	Moderate	Moderate
F_6	Dipslope plateaus, limestone	Good	Moderate	Low
F_7	Folded sedimentary rocks	Fair	Moderate	Moderate
M_1	Semi-arid mountains, all rock except limestone and granite	Fair	Moderate	Moderate
M_2	All limestone mountains	Fair	Low	Low
M_3	Metamorphic rock	Fair	Low	Low
M_4	All grassland mountains	Fair	Moderate	Low
M_5	Overthrust fault mountains	Poor	Moderate	Low
M_6	Slumpy mountains, soft sedimentary rocks	Fair	Moderate	Low
M_7	Subhumid, carbonate belt rocks	Fair	Low	Low
M_8	Granite mountains	Poor	Severe	Severe
M_9	Glaciated belt rocks	Fair	Moderate	Low
M_{10}	All alpine ridges	Poor	Low	Low
M_{12}	Subhumid river breaklands	Poor	Moderate	Moderate
M_{13}	Humid, noncarbonate belt rocks	Fair	Low	Low
M_{14}	Humid, carbonate belt rocks	Fair	Low	Low
M_{15}	Belt rock, fault escarpments	Fair	Low	Low
M_{16}	Belt rock, dip slopes	Fair	Low	Low
M_{17}	Humid, micaceous gneiss and schist	Fair	Severe	Low
M_{18}	High relief volcanic rocks	Fair	Moderate	Moderate
M_{19}	Fault escarpment, gneiss and schist	Poor	Moderate	Low
M_{20}	Rolling volcanic rock mountains	Fair	Moderate	Moderate
M_{21}	Lava flow plateaus	Good	Low	Low
M_{22}	Granite mountains	Fair	Severe	Severe
M_{23}	Lava flow plateaus	Fair	Moderate	Low
M_{24}	Humid river breaklands	Good	Severe	Severe
M_{25}	Belt rocks, noncarbonate	Poor	Low	Low
P_1	Plains benchland	Fair	Moderate	Low
P_2	Dissected shale and sandstone plains	Poor	Moderate	Moderate
P_3	Shale badlands	Fair	Severe	Severe
P_4	Glaciated plains	Good	Moderate	Low
P_5	Plains benchland	Fair	Moderate	Low
P_6	Dissected shale and sandstone plains	Poor	Moderate	Moderate
P_7	Dissected benchlands	Good	Moderate	Moderate
P_8	Dissected benchlands	Good	Moderate	Moderate
P_9	Subhumid prairie sandhills	Fair	Low	Low
P_{10}	Subhumid prairie sandy glacial lake plains	Fair	Low	Low
P_{11}	Rolling sandstone uplands	Fair	Low	Moderate
P_{12}	Highly dissected plains benchland	Fair	Severe	Moderate
P_{13}	Palouse prairie hills	Good	Moderate	Moderate

Source: USDA Forest Service 1976a



LAND SUITABILITY FOR ELECTRICAL TRANSMISSION LINE LOCATION

Source: USFS Region 1 Land Suitability Pattern for Electrical Transmission Lines 1976. Supplemented by TER TEAM

Note: Land suitability mapping between Colstrip and Broadview was not conducted due to the lack of NFS jurisdiction. Suitability and sediment risk ratings for routes in this area were done by TER TEAM

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-6

LAND SUITABILITY MAPPING UNITS

Soils within the transmission corridors can be more specifically identified by using the Land Suitability Map (USDA Forest Service 1976a), Figure III-6. Soils within each of the mapping units are as follows (properties described are normal ranges and do not consider extremes or small inclusions):

A_2 (Alluvial Lands) - Moderately well to poorly drained soils with sandy to clayey surface textures. These soils have developed in a thick layer of sand, silt, and clay deposited in the flood plains of large streams and rivers. Slope gradients range from 0 to 10 percent, and the most common soil suborders (USDA Soil Conservation Service 1975b) are psamments, fluvents, and ochrepts;

B_1 and B_2 (Alluvial Basins) - Well drained clay loams with slope gradients of 0 to 25 percent. These soils have developed in a thick layer of sand, silt, and clay which has washed down from the surrounding mountains. The most common soil suborders are orthids and borolls;

B_3 and B_4 (Glacial Basins) - Well drained loams and silt loams with 0 to 30 percent slopes (0-10 percent slopes in B_3, 10-30 percent slopes in B_4). These soils have developed in a thick layer of material deposited by glacial processes, including sediments precipitated from glacial lakes. The most common soil suborders are borolls, boralfs, psamments, fluvents, and ochrepts;

F_1 (Igneous and Metamorphic Foothills) - Well drained loams with up to 25 percent slopes. These soils have developed in material weathered from a wide range of igneous and metamorphic rocks. The soil suborder borolls is the most common;

F_2 and F_7 (Folded Sedimentary Rocks) - Well drained loams and clay loams with 0 to 25 percent slopes. These soils have developed in materials weathered from shale and sandstone bedrock. The soil suborder boroll is the most common;

F_3 and F_4 (Gravel Capped Benches) - Well drained loams. Slope gradients range from 0 to 10 percent in F_3, and from 15 to 70 percent in F_4. These soils have developed in a sandy and gravelly textured layer of material which was deposited on bedrock by flowing water. The soil suborder boroll is the most common;

F_5 (Hogback Ridges, Hard Sedimentary Rocks) - Well to excessively drained loams with 25 to 60 percent slopes. These soils developed in material weathered from sandstone and shale bedrock. The most common soil suborders are orthents and borolls;

F_6 (Dipslope Plateaus, Limestone) - Well drained loams with 0 to 25 percent slopes. These soils developed in material weathered from limestone bedrock. The soil suborder boroll is the most common;

F_7 - see F_2 above;

M_1 (Semi-arid Mountains, all rock except limestone and granite) - Well drained loams with 25 to 60 percent slopes. These soils developed in material weathered from a wide range of bedrock types excluding limestone and granite. The most common soil suborders are borolls and boralfs;

M_2 (Limestone Mountains) - Well drained silt loams with 25 to 60 percent slopes. These soils developed in material weathered from limestone bedrock. The most common soil suborders are borolls and ochrepts;

M_3 (Metamorphic Rocks) - Well drained loams with 25 to 60 percent slopes. These soils developed in material weathered predominantly from gneiss, with lesser amounts of quartzite and argillite. The most common soil suborders are boralfs and ochrepts;

M_4 (Grassland Mountains) - Well drained loams with 35 to 70 percent slopes. These soils developed in material weathered from a wide range of bedrock types. The most common soil suborders are borolls and ochrepts;

M_7 and M_{14} (Subhumid and Humid Carbonate Belt Rocks) - Well drained loams and silt loams with 30 to 70 percent slopes. These soils developed in material weathered from argillite, quartzite, and limestone. The most common soil suborders are ochrepts, orthents and boralfs;

M_8 (Granite Mountains) - Well drained sandy loams with 25 to 60 percent slopes. These soils developed in material weathered from granitic bedrock. The most common soil suborders are boralfs and ochrepts;

M_9 (Glacial Belt Rocks) - Well drained silt loams with 20 to 60 percent slopes. These soils developed in material deposited by glaciers in mountainous terrain. The most common soil suborders are ochrepts and boralfs;

M_{12} (Subhumid River Breaklands) - Well to excessively drained loams with slope gradients greater than 60 percent. These soils developed in material weathered from a wide variety of bedrock. Much of the area consists of rock outcrops and talus slopes with no soil. Where soils have developed, the soils suborder orthents is the most common;

M_{13} and M_{25} (Noncarbonate Belt Rocks) - Well drained loams and silt loams with 30 to 70 percent slopes. These soils developed in material weathered from noncarbonate quartzite and argillite. The most common soil suborders are ochrepts and orthents;

M_{14} - see M_7 above;

M_{18} (High Relief Volcanic Rocks) - Well drained loams with 35 to 70 percent slopes. These soils developed in material weathered from extrusive volcanic rocks. The most common soil suborders are ochrepts, orthents, and boralfs;

M_{20} (Volcanic Rocks) - Well drained loams with 25 to 60 percent slopes. These soils developed in material weathered primarily from basalt and andesite bedrock. The soil suborder ochrepts is the most common;

M_{25} - see M_{13} above;

P_1 and P_5 (Plains Benchland) - Well drained loams and clay loams with 0 to 10 percent slopes. These soils developed in material weathered from sandstone and shale. The soil suborder borolls is the most common;

P_2 and P_6 (Dissected Shale and Sandstone Plains) - Well drained clay loams and loams with 0 to 25 percent slopes. These soils developed in material weathered from shale and sandstone bedrock. The most common soils suborders are borolls and orthents;

P_3 (Shale Badlands) - Excessively drained loams and clay loams with 0 to 60 percent slopes. These soils developed in material weathered from shale bedrock. There has been no soil development on many of the steeper slopes, but where soils have developed, the most common soil suborder is orthents;

P_4 (Glaciated Plains) - Well drained loams and clay loams with 0 to 10 percent slopes. These soils developed in a thick layer of material deposited by continental glaciation. The soil suborder borolls is the most common;

P_5 - see P_1 above;

P_6 - see P_2 above; and

P_7 (Dissected Benchlands) - Well drained loams and clay loams with 0 to 40 percent slopes. These soils developed in material weathered from sandstone and shale. The soil suborder borolls is the most common.

SUITABILITY OF SOILS FOR USE

Land Suitability Pattern for Electrical Transmission Lines (USDA Forest Service 1976a) contains suitability ratings for all the mapping units. Of the mapping units which are crossed by the proposed or alternative corridors, B_1, B_2, B_3, B_4, F_3, F_4, F_6, P_1, P_4, and P_5 have a "good" rating; A_2, F_1, F_2, F_5, F_7, M_1, M_2, M_3, M_4, M_7, M_9, M_{13}, M_{14}, M_{20}, M_{25}, P_2, P_6, and P_7 have a "fair" rating; and M_8, M_{12}, M_{18}, and P_3 have a "poor" rating (see Figure III-6). For an explanation of the rating system, see the Land Suitability discussion (Chapter IV) and in the above mentioned publication.

INHERENT HAZARDS

Eight primary hazards are the basis for the fair and poor suitability ratings given certain mapping units. These mapping units and the hazards which apply to them are shown in Table III-2. The Colstrip to Broadview area was not included in the land suitability map, but suitability ratings were assigned by the Study Team. The primary hazards for the "fair" rated part of the Colstrip to Broadview area are similar to those described for P_2 except in the vicinity of the Yellowstone and Little Big Horn Rivers where they are similar to those for A_2.

SURFACE WATER

Since the likelihood of groundwater being significantly impacted by construction and maintenance of the transmission lines is remote, the description of water within the study area is confined to surface water. Contamination by herbicides could be a potential impact on ground water, but the Applicant has declared that "Herbicides will not be used during construction or maintenance of this line" (WESD/AEA 1973:3-81).

IMPORTANT WATER FEATURES

Rivers and streams comprise by far the most abundant form of surface water within the study area. The eastern two-thirds of the study area drains to the Gulf of Mexico by way of the Missouri, Yellowstone,

Table III-2 - MAJOR SOIL AND TOPOGRAPHIC HAZARDS

MAPPING UNIT	WATER EROSION AND SEDIMENT	LANDSLIDES AND SLUMPS	STEEP SLOPES	ROCK OUTCROP	FLOODING/SEASONAL HIGH WATER TABLE	FROST HEAVING AND DUST	SOILS VERY MUDDY WHEN WET	SHALLOW SOILS OVER HARD MASSIVE ROCK
A_2	-	-	-	-	X	X	-	-
F_1	X	-	-	-	-	X	-	-
F_2	X	-	-	-	-	-	-	-
F_5	X	-	X	X	-	-	-	-
F_7	X	-	-	-	-	-	-	-
M_1	X	-	X	-	-	-	-	-
M_2	-	-	X	X	-	-	-	-
M_3	-	-	X	-	-	-	-	-
M_4	-	-	X	-	-	-	-	-
M_7	-	-	X	-	-	-	-	-
M_8	X	-	X	-	-	-	-	-
M_9	-	-	X	-	-	-	-	-
M_{12}	-	-	-	X	-	-	-	X
M_{13}	-	-	X	-	-	-	-	-
M_{14}	-	-	X	-	-	-	-	-
M_{18}	X	X	X	-	-	-	-	-
M_{20}	-	X	X	X	-	-	-	-
M_{25}	-	-	X	-	-	-	-	-
P_2	X	-	-	-	-	-	X	-
P_3	X	-	-	X	-	-	X	-
P_6	X	-	-	-	-	-	X	-
P_7	-	-	X	-	-	-	-	-

Source: USDA Forest Service, 1976

Musselshell, and Smith Rivers of the Missouri River Basin. The western one-third drains to the Pacific Ocean by way of the Clark Fork and Flathead Rivers of the Columbia River Basin (see Figure III-7).

Lakes and ponds are much less numerous than rivers and streams in the study area, and wetlands are few in number. With the exception of Canyon Ferry Lake near Helena (an impoundment on the Missouri River), the lakes are small. Some of the wetlands (shown in Figure III-21) are saturated for only a short period of time following spring snowmelt. Classifying such areas as wetlands is debatable, but they were included in order that wetlands receive full consideration during corridor evaluation.

WATER QUALITY

The quality of Montana streams varies considerably from one part of the state to another. As a general rule, the streams in western Montana tend to be of better quality than the streams of eastern Montana.

Land management plans prepared for numerous USDA Forest Service planning units within the study area indicate that most mountain streams with forested watersheds are of excellent quality. Some of the mountain streams in the vicinity of Butte and Helena, however, have been degraded by mining activities.

Water quality data for most rivers and a few streams have been gathered by the State of Montana Water Quality Bureau and by the U.S. Geological Survey (Montana Water Quality Bureau 1975a, b and 1976a, b, c; U.S. Geological Survey 1976). While these data do not reveal the quality of most small streams within the study area, they do indicate that many of the rivers and a few of the streams have been degraded by one kind of pollutant or another. Sediment is the most widespread form of pollution; it is present in portions of every river basin in the study area. Other pollutants (or indicators of pollutants) present in specific parts of the study area are mining wastes, salts, temperature, nutrients, and coliform bacteria.

Sediment originates from agricultural practices and construction, logging, and mining activities as well as from natural causes. Pollution from mining wastes is concentrated in the part of the study area surrounding Butte and Helena, especially in the central Boulder, upper Clark Fork, and upper Blackfoot Rivers and in Silver Bow and Prickly Pear Creeks. Salts, nutrients, and abnormal temperatures result primarily from agricultural practices. Salts are a problem in the eastern third of the study area where their concentration in surface waters has been increased by irrigation return flows. Nutrients and abnormal temperatures are a problem in streams receiving irrigaton return flows in the eastern two-thirds of the study area. Some of the increased temperatures may also be due to reduced flows following irrigation withdrawals. Coliforms are often indicators of human wastes, and they are a problem at numerous locations throughout the study area where improperly treated domestic sewage is allowed to reach a stream.

The Montana State Department of Health and Environmental Sciences has adopted water quality standards for all state waters (MDHES 1974). The parameters used to establish the state standards are as follows:

coliform content
dissolved oxygen concentration
hydrogen ion concentration (pH)
turbidity
temperature
sediment and settleable solids concentration
pesticide, heavy metal and toxic substance concentration
true color

The state water quality standards consist of four main classification groups: A, B, C, and E.

Waters classified as "A" have the highest standards. They are intended to be maintained as "Water supply for drinking, culinary and food processing purposes suitable for use after simple disinfection," or "after simple disinfection and removal of naturally present impurities,"

HYDROLOGICAL FEATURES AND RECREATION WATERWAYS

Rated Trout Streams

- 🟦 Class I
- 🟥 Class II
- 🟩 Class III
- 🟨 Class IV

Source: MDFG no date

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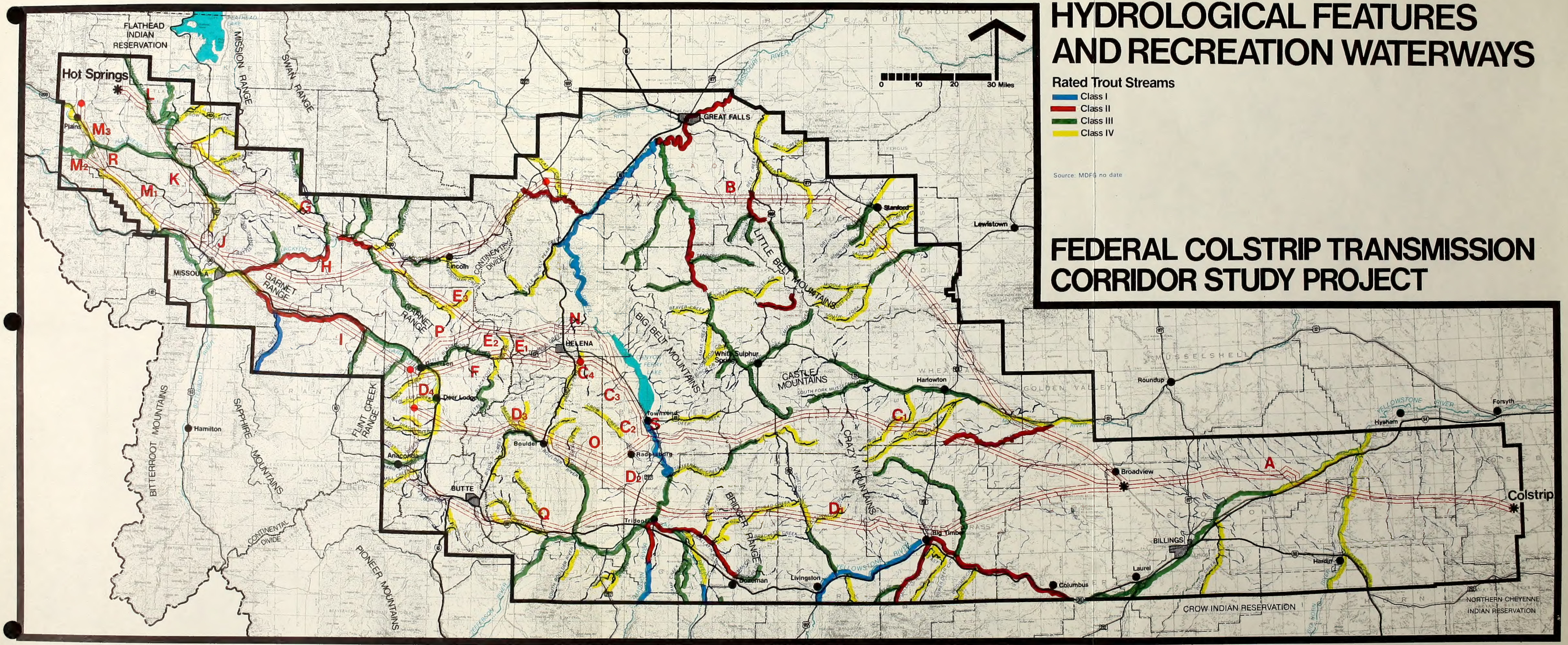


Figure III-7

depending on which of the two A subdivisions is applicable to the particular stream (MDHES 1974). Four of the alternative transmission corridor segments cross streams which have been assigned an A classification. Those segments, the A classified streams they cross, and the municipalities to which they furnish water are as follows:

Corridor Segment (Figure IV-3)	Stream Crossed (Figure III-7)	Municipal Water Supply
A-4	Tin Cup Joe Creek	Deer Lodge
A-8	Lyman Creek	Bozeman
B-3-1	Rattlesnake Creek	Missoula
B-15	Ten Mile Creek	Helena

State law does not preclude crossing the above named streams by the transmission line. However each municipal watershed is managed according to local constraints, and the actual crossing would require negotiation with the appropriate land managing body. (Refined information obtained for the Step 3 analysis revealed that none of the corridors cross the A-classified portions of these streams.)

Waters classified as "B" have the second highest standards within the state system. They are intended "to be maintained suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities . . ." (MDHES 1974). Most of Montana's streams are within this classification. All of the water bodies crossed by transmission line corridors which are not specifically mentioned in the other three classification groups are in this classification.

Waters classified as "C" have the third highest standards within the state system. They are intended "to be maintained suitable for bathing, swimming and recreation; growth and propagation (or marginal propagation) of salmonid fishes and associated aquatic life, waterfowl and furbearers . . ." (MDHES 1974). The only corridor segments which cross a "C" classified stream are segments B-12-2 and B-17 where they cross the Clark Fork River (see Figure IV-3).

Waters classified as "E" have the lowest standards within the state system. They are intended "to be maintained for agricultural and industrial water uses other than food processing" (MDHES 1974). The only corridor segments which cross "E" classified streams are segment A-5 where it crosses Silver Bow Creek, and segment C-5 where it crosses Prickly Pear Creek (see Figure IV-3).

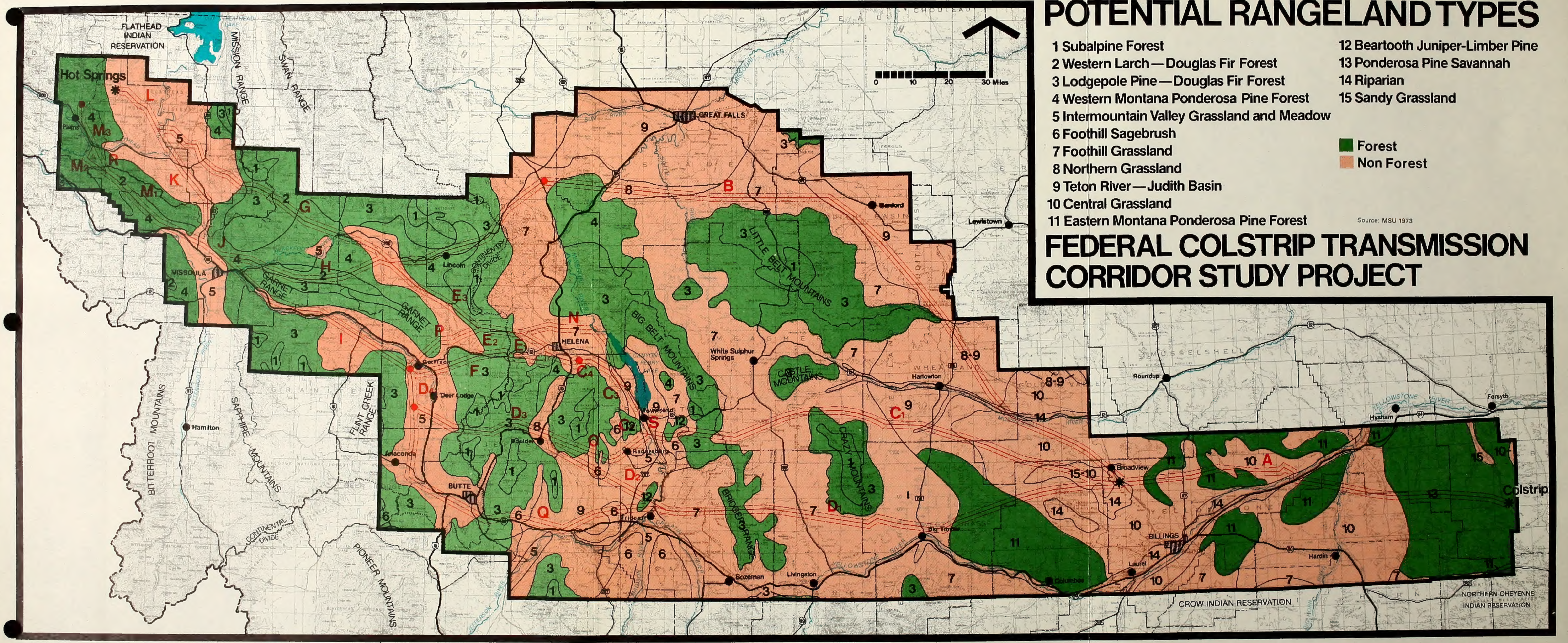
In addition to authorizing water quality standards, the state water quality law has a nondegradation clause. This clause states that ". . . any state waters, whose existing quality is higher than the established water quality standards, be maintained at that high quality . . ." (Montana Water Quality Bureau 1977:8). It is therefore illegal to reduce the quality of any state waters, even if the quality of those waters is not reduced below the state standards.

VEGETATION

PRINCIPAL VEGETATION TYPES

The Vegetative Rangeland Type Map in Bulletin 671 (MSU 1973) was used in this analysis to display the vegetative types within the study area (note Figure III-8). The boundaries between forest and non-forest land were refined using 1973 satellite imagery. The following discussion describing the vegetative types crossed by the Applicant's proposal, and the alternatives was compiled from the following sources: The Westinghouse Report (WESD/AEA 1973); the State's Draft EIS (DNRC/DEIS 1974); MSU 1973, Vegetative Rangeland Types in Montana, Bulletin 671; Pfister, 1977, Forest Habitat Types of Montana; and the unpublished consultant's report titled Preliminary Study of Rangeland and Forest Cover Types Within Proposed Zone of Influence (Montana), Chaffee 1973.

In the mountainous western portion of the state, vegetation types were classified by forest cover type, such as lodgepole pine and Douglas fir.



POTENTIAL RANGELAND TYPES

1 Subalpine Forest
2 Western Larch—Douglas Fir Forest
3 Lodgepole Pine—Douglas Fir Forest
4 Western Montana Ponderosa Pine Forest
5 Intermountain Valley Grassland and Meadow
6 Foothill Sagebrush
7 Foothill Grassland
8 Northern Grassland
9 Teton River—Judith Basin
10 Central Grassland
11 Eastern Montana Ponderosa Pine Forest
12 Beartooth Juniper-Limber Pine
13 Ponderosa Pine Savannah
14 Riparian
15 Sandy Grassland

🟩 Forest
🟧 Non Forest

Source: MSU 1973

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-8

Typing in the plains area is complicated by a monotonous expanse of grassland predominated throughout by four species of grass and one sedge. These are: blue grama, western wheatgrass, needle-and-thread, Sandberg bluegrass, and threadleaf sedge. Since certain species predominate throughout this vast area, it was necessary to distinguish vegetation type changes on the basis of other factors. In some areas, a distinctive minor species stands out sharply, as in the case of little bluestem in the grassland of extreme northeastern Montana. In other cases, the distinctive feature may be topographical, such as the badlands along the lower Yellowstone River (MSU 1973).

Subalpine Forest

The subalpine or spruce-fir forest community occurs in very rough mountainous areas at elevations between 5,000 feet and timberline. The precipitation in this zone is over 30 inches and the soils range from sandy loams to rocks. This zone consists of dense to open forests of low to medium-tall needleleaf evergreen trees. Patches of snow last to midsummer, and the meadows are lush and green.

The species that distinguish this community are subalpine fir and Engelmann spruce; however, whitebark pine and subalpine larch also occur, sometimes at the highest interfaces with the alpine zone. Lodgepole pine and quaking aspen may occur in burned-over areas within the lower portions of the subalpine forest. Foreage species include sedges, Idaho fescue, bluegrass and bent.

The subalpine forest is desirable summer range for sheep, but does not withstand trampling and trailing very well. It has been seriously overgrazed in the past.

Estimated carrying capacities of present forage stands are about 12.5 acres per Animal Unit Month (a/AUM). Potential capacities are estimated at 4 a/AUM. The estimated present average annual herbage yield is 300 pounds per acre. The average timber productivity is low, but volumes may attain 13,400 board feet per acre on the best sites.

Western Larch - Douglas Fir Forest

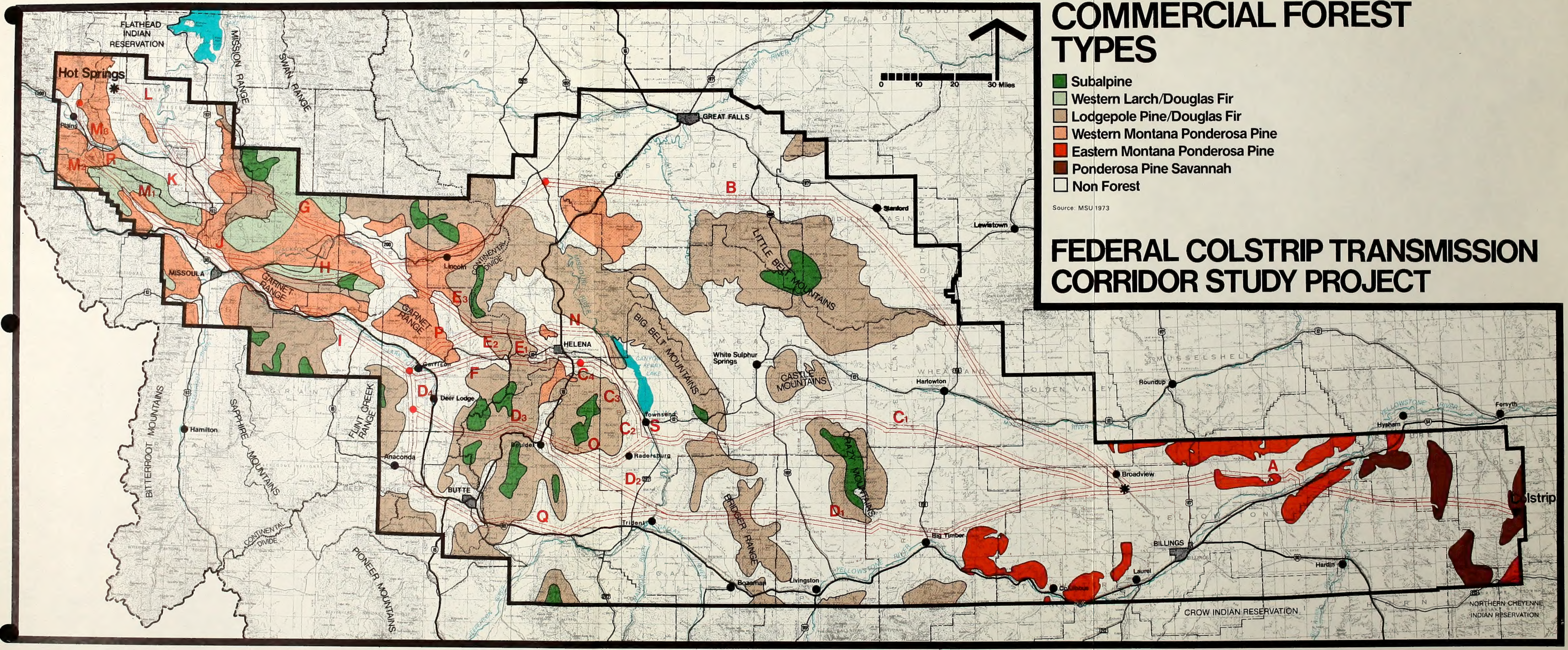
The western larch - Douglas fir forest is a medium-dense, shady forest of medium-tall to tall needleleaf trees, and is found in rough, mountainous areas as well as on benches and lower midslopes on the west side of the Continental Divide. Elevations generally range from 3,000 to 6,000 feet and precipitation ranges from 20 to over 40 inches per year. A variety of shrubs and herbaceous plants occurs depending on climate, soil, forest density, and past fire and logging history.

The characteristic species in this community is Douglas fir; however, there is considerable intergradation of other species. Engelmann spruce and true firs, typical of the subalpine forest, occurs in higher regions and north-facing slopes; ponderosa pine occurs at lower elevations, areas receiving less precipitation, and on south-facing slopes; and whitebark pine and limber pine occur along exposed ridges. In western portions of the study area there are extensive stands of western larch. The site index for trees measured on a 50-year base averages 80 feet. Potential productivity is high with growth averaging 95 cubic feet per acre per year. The range is 85 to 120 cubic feet per acre per year.

The western larch - Douglas fir forest is of little value for domestic stock. This community is important though as big game range, especially white-tailed deer. The estimated carrying capacity for this forest type is 32 a/AUM. The potential carrying capacity is about 23.5 a/AUM.

Lodgepole Pine - Douglas Fir Forest

This forest community occurs on extensive areas in Montana, primarily at elevations of 5,000 to 7,500 feet east of the Continental Divide (see Figure III-9). It is typically located on well-drained upland sites with gentle topography. Precipitation is from 15 to 40 inches. Pine reedgrass predominates on the better soils and grouse whortleberry on the poorer soils.



COMMERCIAL FOREST TYPES

- 🟩 Subalpine
- 🟩 Western Larch/Douglas Fir
- 🟫 Lodgepole Pine/Douglas Fir
- 🟧 Western Montana Ponderosa Pine
- 🟥 Eastern Montana Ponderosa Pine
- 🟫 Ponderosa Pine Savannah
- ☐ Non Forest

Source: MSU 1973

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-9

The principal tree species include lodgepole pine, Douglas fir, subalpine fir, grand fir, Engelmann spruce, western larch, and some ponderosa pine. The site index averages 50 for the east side and 50 to 60 for the west side. The overall potential productivity is moderate. Eastside forests will produce 50 to 55 cubic feet per acre per year, whereas to the west the range is 75 to 90 cubic feet per acre per year, averaging 80 cubic feet.

The dominance of lodgepole pine within this community may be due to the following factors (Pfister, et. al. 1977):

1. Historic, repeated wildfires over large areas may eliminate seed sources of potential shade-tolerant competitors;
2. Light ground fires may remove invading shade-tolerant competitors from the understory;
3. Dense stands may prevent regeneration of all conifers for up to 200 years in the absense of disturbance or stand deterioration; or
4. Sites may be unfavorable for the establishment of other conifers.

Stands show evidence of light use (primarily spring to fall) by mule deer, elk, and occasionally moose. In dense stands, shading limits forage production to such an extent that grazing becomes impractical. Other forage species which distinguish this type are elk sedge and bluegrasses. The present carrying capacity is about 8 a/AUM, while the potential carrying capacity is 7 a/AUM.

Herbage yields vary greatly depending upon the canopy coverage of the community and the site factors of soil depth, moisture, and elevation. Examples of herbage yields from studies conducted on Douglas fir habitat types indicate potential production as follows (McLean 1971):

Habitat Type	Estimated Average Yield
Douglas fir/bluebunch wheatgrass	400 lbs/acre
Douglas fir/Idaho fescue	800 lbs/acre
Douglas fir/pinegrass	600 lbs/acre

Western Montana Ponderosa Pine Forest

In many areas of the Rocky Mountains, the first forest zone above the grassland is western ponderosa pine forest. This species can tolerate drier environments better than most other native conifers with the exception of limber pine and Rocky Mountain juniper which form localized zones of climax vegetation (Pfister, et. al. 1977). This forest varies in elevation from 2,500 to 7,000 feet. Precipitation varies from 15 inches at the lower elevations to 30 inches or more in the mountainous areas. Tree species commonly found with the ponderosa pine include Douglas fir, western larch and lodgepole pine. The site index averages 60 over the broad range of this type. The average potential productivity is high on the better sites, with an average annual growth of 85 cubic feet per acre. The range in growth is 60 to 100 cubic feet per acre per year.

The eastern and western ponderosa pine types of Montana have many species in common. The western type, however, is characterized by heavier stands of pine and higher percentages of mountain species such as pine reedgrass, elk sedge and blue grasses, which are the principal forage species. The eastern type contains more plains grasses such as needle-and-thread and blue grama, and is a much more open forest.

The western ponderosa pine type is one of the most important forage producing forest cover types in the montane physiographic area. The lower elevation pine types with 10-30 percent crown cover are the principal forage producers.

An overall assessment of this forest type would indicate that heavy grazing and logging activities have reduced the forage value significantly in the lower elevations where easy access is available. Estimated carrying capacities of present stands in fair to good condition are from 5 to 10 a/AUM. Potential capacities are estimated at 3.0 to 3.5 a/AUM on excellent condition ranges. Estimated herbage yields are about 500 to 700 pounds per acre on fair to good condition range under normal annual rainfall conditions. Cheatgrass brome, an introduced invader species, has greatly increased as a result of heavy livestock grazing, accounting for the reduced forage value.

Intermountain Valley Grassland and Meadow

The topography of this vegetation zone consists of narrow to moderately broad valleys. Elevations range from 2,500 to 3,500 feet, and sometimes higher. Precipitation ranges from 12 to 18 inches.

Much of the valley land formerly occupied by this vegetative type is now devoted to the production of hay and cultivated crops. Many prosperous ranches are located in these intermountain valleys. With the current trend in development and subdivision, and poor livestock management, native grassland and meadow range conditions are considered problem areas relative to soil disturbance and loss of forage production. Impacts have been caused by railroads and developments for some time, particularly along the Clark Fork River drainage to Missoula and west.

The grazing areas have changed extensively because of heavy grazing from a rough fescue to Idaho fescue-bluebunch wheatgrass with significant extents of cheatgrass invasion. The present carrying capacity is estimated at 2 to 5 a/AUM. The potential is estimated to be 1.5 a/AUM. Current herbage yields vary greatly due to disclimax conditions on native ranges and meadows. Short and mid-grasses and forbs have succeeded tall grasses and have reduced production substantially. Wet meadow types with bluegrass, sedge, and bent are capable of producing 1,500 to 2,000 lbs/acre.

Foothill Sagebrush

The sagebrush zone is located in foothills and high basins at elevations from 5,000 to 6,000 feet. Precipitation is between 10 and 14 inches.

The distinguishing features of this region are rolling hills and choppy, steep slopes with scattered pine and juniper. Relict areas indicate that the original vegetation type consisted of a thick stand of Idaho fescue with some sagebrush. Bluebunch wheatgrass occurs on the poorer soil types which are limited in extent. The change under heavy grazing has been extensive, the outstanding change being the heavy invasion of sagebrush.

The status of sagebrush in the climax grassland community type is conjectural. On topographic sites where soil complexes are prevalent, sagebrush may be climax to a large extent. On the deeper soils of basins and benches with past heavy grazing, big sagebrush and rabbitbrush will be competitive and can dominate the community type.

The sagebrush-grass community type can be a productive range providing a good annual yield of herbaceous and woody plant forage for livestock, big game, and sage grouse.

Sagebrush may reflect xeric conditions in interfoothill physiographic areas (Whitehall & Townsend areas) in a low 10-20 inch precipitation zone and is a principal component of the 15-19 inch precipitation foothill grassland type (White Sulphur Springs area). Sagebrush interfaces with the Douglas fir type in the montane forest and open ponderosa pine type in the 10-15" precipitation zone.

The present carrying capacity for this type is about 4 to 5 a/AUM, with a potential of from 3 to 3.5 a/AUM. Estimated present herbage yields on a typical sagebrush community vary tremendously depending on the present composition of sage. A sagebrush/grassland type in good condition in the 10-15 inch rainfall zone would produce in the range of 500 to 1,000 lbs/acre (Blaisdell 1958). The principle forage species in this type are bluebunch wheatgrass, Idaho fescue, and big sagebrush.

Foothill Grassland

This vegetation zone is comprised of rolling foothills from the lower edges of the timber types, merging to the sedimentary plains. It also includes some wide valleys and benchlands. Elevations range from 4,000 to 5,500 feet. Soils are usually shallow due to the steep slopes. Precipitation in this zone is generally from 14 to 20 inches with localized variations.

The distinguishing features of the foothill grasslands are the admixture of plains and mountain species and the predominance of wheatgrasses and fescues. The chief wheatgrasses are bluebunch wheatgrass and western wheatgrass. The chief fescues are Idaho fescue and sheep fescue. Another distinguishing feature is the shrub and tree covered canyons that descend into this type.

This vegetation type, occurring at a higher elevation than the Intermountain Valley Grassland and Meadow type, receives more precipitation and produces more forage. It is, in fact, one of the best forage types in the state. Competition for grazing land over large portions of this type is keen due to the considerable number of ranches located along the streams, and land values are often much higher than is warranted on the basis of grazing values.

Due to the complexity of soils and slope gradients, this extensive range type often shows considerable variation in species composition. Examples of current productive capacity and actual condition class are cited below from several sample areas within this type.

Foothill Range (Continental Divide Area) - When rough fescue, bluebunch wheatgrass, Idaho fescue, sedges, and associate species comprise 50 percent or more of the herbage production, the ranges are in good condition (USDA Soil Conservation Service 1971). Approximately 50 percent of the foothill divide types in Montana are in good condition in the 15-19" rainfall zone. Mesic swales or valleys within the foothills with high water tables support a dominance of blue grasses, sedges, and forbs, and reflect heavier grazing use. Average overall estimated condition class of these mesic subtypes is fair, producing only 40-50 percent of their potential 1,500 to 2,200 lbs/acre (Dyksterhuis 1964).

Central Foothill Range (Park County to Judith Basin County Area) - This foothill subtype lies between the higher Continental Divide communities and the Great Plains grassland ecotone. This type gradually interfaces with plains dominant grasses such as western wheatgrass, needle-and-thread, and blue grama found on the benchlands and valleys.

Present estimated herbage yield under normal precipitation is between 700 to 1,400 lbs/acre. The present overall livestock carrying capacity for this vegetative type is 3 to 4 a/AUM. The potential carrying capacity is 2.5 to 3 a/AUM.

Northern Grassland

This type is located in only two places within the study area. One site is about 20 miles southwest of Great Falls on the west bank of the Missouri River in Chestnut Valley, and extends about 20 miles due east of the river (Figure III-8). The other site is near Harlowton to the north of the Musselshell River. The topography of both sites is glaciated and rolling. Elevations range from 3,400 to 4,500 feet in Chestnut Valley, and from 4,200 to 4,600 feet north of the Musselshell River. The average annual precipitation is from 16 to 20 inches.

The principle forage species are blue grama, western wheatgrass, and dryland sedges. The sedges are threadleaf sedge and needleleaf sedge. This type is distinguished by clubmoss and fringed sagewart.

The Chestnut Valley and surrounding area lies in one of the big grain belts of Montana, and all of the more productive, gently sloping sites are now agricultural land. The same is true to the north and northwest of Harlowton where agriculture is the dominant land use. Little native grass can be found over much of this area. The present carrying capacity is 4.5 a/AUM. The potential is rated at about 3.5 a/AUM.

Teton River-Judith Basin Grassland

The topography of this type is gently sloping to rolling. Elevations vary from 3,700 to 4,500 feet, and the zone of precipitation is mostly from 15 to 19 inches.

The principal forage species are blue grama, needle-and-thread, and western wheatgrass. The type is distinguished by Sandburg bluegrass and prairie junegrass. The native grass is very productive, but much of the better land has been broken for grain production. The portion of this type extending south of Judith Gap has less productive soils and lighter precipitation that is reflected in a decrease in grass density and lower carrying capacity.

The soil capability of this vegetative type is generally rated good to excellent. Estimated herbage yield on silty and clayey sites presently varies from 800 to 1,500 lbs/acre. On thin and shallow soils, the estimated rate under normal annual precipitation and moderate grazing is 700 to 1,300 lbs/acre. Within this community is also found sub-irrigated and overflow sites capable of producing an estimated 3,000 to 4,000+ lbs/acre during favorable growing seasons. The present livestock carrying capacity is from 3 to 4 a/AUM, while the potential is from 2.5 to 3 a/AUM.

Central Grassland

The topography of the central grasslands varies from plains to rolling slopes with occasional escarpments. Precipitation varies between 10 and 15 inches, and elevations range between 2,500 and 5,000 feet. Most of this area consists of open to fairly dense grass cover.

Blue grama, western wheatgrass, and needle-and-thread are the principal forage species. The present distinguishing feature is the general prevalence of big sagebrush in association with western wheatgrass and blue grama throughout this type. Associated species include silver sage found primarily in the coulee bottoms and other areas where moisture conditions are better, and fringed sage, bluebunch wheatgrass and needlegrass. Areas with thin soils over bedrock reflect topoedaphic situations in which pine/juniper, and skunkbrush sumac/bluebunch wheatgrass are associated on slopes, ridge crests, and hillsides.

Needle-and-thread is at present the dominant grass over northern Musselshell County. Western wheatgrass is more abundant on the heavier soils such as those occurring in northern Fergus County. The central grassland is inferior farm land and only fair rangeland in comparison with most other grassland types within the study area. The boundary of this type is drawn at the line where big sagebrush disappears.

Productivity within this site varies considerably due to the complexity in depth and aspect of the soils. Present herbage yields from several typical sites in this type are:

> In the 10 to 14 inch precipitation zone, silty, sandy and clayey sites produce between 700 to 1,400 lbs/acre.
>
> Sites that are strongly saline produce an estimated yield of 300 lbs/acre under normal rainfall years. During low precipitation periods, very little herbage production is evident.

The estimated present carrying capacity of this type is 4 to 5 a/AUM, while the potential capacity is about 3 to 3.5 a/AUM.

Eastern Montana Ponderosa Pine Forest

The eastern ponderosa pine forest is found in the eastern portion of the study area on rough, broken land, primarily along the Missouri and Yellowstone Rivers. Elevations are mostly between 3,500 and 4,500 feet, and precipitation is between 12 and 20 inches. This open forest is generally poorly stocked but pockets of medium and well-stocked stands occur in many of the draws. The principal tree species are ponderosa pine and Rocky Mountain juniper. The site index averages 50 for the better sites. The overall potential productivity rating is moderate as the growth is approximately 50 cubic feet per acre per year. Where the timber is open-growth, the understory of grasses is usually heavy. A sprinkling of little bluestem helps to distinguish this type from the western ponderosa pine forest.

The principal forage species are bluebunch wheatgrass, western wheatgrass and bluegrass. Other species often found in this type are Rocky Mountain juniper, snowberry, blue grama, needle-and-thread, and Idaho fescue. Livestock carrying capacity is presently 3.5 to 4 a/AUM, whereas the potential capacity is 3 to 4 a/AUM. Grazing has been lighter than on most of the other vegetation types within the study area because of the rough topography and lack of stock watering facilities. For this reason it is noted that the present carrying capacity differs little from the estimated potential capacity.

Herbage production is moderately high on this community type, with an estimated production range of between 700 to 1,300 lbs/acre under normal rainfall years.

Beartooth Juniper - Limber Pine

Within the study area, the beartooth juniper - limber pine community is found only in two small areas just west and east of Townsend. The topography here is rough, rocky foothills overlooking the Missouri River. The average annual precipitation is between 12 and 16 inches. This type is found between 4,000 and 5,000 feet.

The principal forage species are threadleaf sedge, blue grama, and bluebunch wheatgrass. Rocky Mountain juniper, limber pine, and mountain mahogany characterize this wild, rugged type.

This community, like the eastern Montana ponderosa pine vegetative type, has been little grazed by livestock because of the shortage of livestock water and the rugged topography. The livestock carrying capacity is considered poor, with both the actual and potential carrying capacity rated at 10 a/AUM.

Ponderosa Pine Savannah

The ponderosa pine savannah, located in the eastern part of the study area with rolling to hilly topography, is between 3,500 to 4,000 feet in elevation. Average annual precipitation ranges between 11 to 17 inches.

The distinguishing feature of this forest type is the rather large areas of somewhat broken terrain with tree cover along escarpments, draws, and ridges, that are interspersed with large grassy open areas. This is not a typical savannah however, due to the fact that the ponderosa pine tends to be distributed in patches on rougher land throughout the area, rather than as scattered individuals with uniform distribution. Although some of these patches are rather large, there are also extensive areas of open grassland. Under heavy use and absence of fire, savannah sites tend to develop into a continuous canopy of woody plants (Dyksterhius 1957). Principal tree species include ponderosa pine and Rocky Mountain juniper. The site index is low (under 40). The potential productivity averages 35 cubic feet growth per acre per year.

The principal forage species are western wheatgrass, bluebunch wheatgrass, and blue grama. Other associated species include Rocky Mountain juniper, skunkbrush sumac, common snowberry, Sandburg bluegrass, needle-and-thread, little bluestem, buffalo grass and Idaho fescue.

The present carrying capacity is 4 a/AUM. Potential carrying capacity is estimated at 3 a/AUM. This type offers desirable understory grasses and shrubs for livestock and wildlife grazing.

Riparian

Riparian community types are located along drainage areas or flood plains. The two largest riparian zones within the study area border the Yellowstone and the Missouri River in the east and northcentral portions. Elevations range from 2,500 to 4,500 feet; annual precipitation is from 10 to 20 inches.

The principal forage species are Kentucky bluegrass, western wheatgrass, cheatgrass brome, timothy, and bearded wheatgrass. The overstory cottonwood trees, associated with willow and others such as western chokecherry and dogwood, characterize this community type.

The estimated condition of this type is fair to good with the present carrying capacity rated 3 to 4 a/AUM. The potential carrying capacity is rated at 1.5 to 2 a/AUM. Estimated herbage yield varies between 500 to 2,400 lbs/acre, depending on the density of overstory vegetation along the river drainages.

Sandy Grasslands

The sandy grasslands topography varies from undulating to hilly, and the only location of this type within the study area is about 25 miles northwest of Billings. The average annual precipitation is 10 to 14 inches and the elevation ranges from 3,900 to 4,200 feet.

The principle forage species are needle-and-thread, prairie sandreed and threadleaf sedge. Very few shrubs occur on this site. Rose, silver sagebrush, and skunkbrush sumac are found on rare occasions.

This is a very productive type where rainfall is above 12 inches. It is easily damaged by overgrazing and quickly becomes subject to wind erosion. The present carrying capacity is about 5.5 a/AUM, while the potential is 2.5 a/AUM.

THREATENED AND ENDANGERED PLANT SPECIES

Four plant species have been identified as threatened or endangered in Montana at this time based on a study conducted for the U.S. Forest Service by T. J. Watson, Jr., Assistant Professor of Botany, University of Montana, in September 1976.

The Endangered Species Act of 1973 (Public Law 93-205), approved December 28, 1973, requires that Federal agencies shall take necessary action to ensure that actions authorized, funded or carried out by them do not jeopardize the existence of endangered and threatened species or result in the destruction or modification of the critical habitat of those species. Endangered species are usually rare, with a geographically limited distribution, and are in danger of becoming extinct throughout a significant portion or all of their range. Threatened species are not endangered at present, but may become so throughout a significant portion or all of their range.

As a result of the Endangered Species Act, the Smithsonian Institution submitted a list of plant species suspected of being threatened or endangered in the United States. This list was printed in the Federal Register of July 1, 1975. Ten species on the list are located in Montana. This list was later revised by the Office of Endangered Species of the U.S. Fish and Wildlife Service and published in the Federal Register of June 16, 1976. The new list eliminated eight of the species previously included in Montana but added one species.

The act recognized that the destruction or modification of a species' habitat can result in the species' extinction. Accordingly, the U.S. Fish and Wildlife Service is grathering information to assist in delineating spacial environments, including geographical boundaries, when possible, considered to be "critical habitat" for endangered and threatened species (USDI 1976). At the present time, there have been no critical habitat areas designated for any plant species found within the study area.

The Fish and Wildlife Service emphasizes that there can be certain actions that may not be detrimental to critical habitat areas. Consequently, there may be certain actions which can be undertaken in critical habitat areas that would not be expected to result in such a reduction in either distribution or numbers of a species, or otherwise adversely affect a species (USDI 1976).

A biological opinion from a regional Fish and Wildlife Service officer would be required if a proposed endangered or threatened plant species should be encountered by a future field survey because: (1) at the present time the list of threatened and endangered plant species is only a proposal, (2) critical habitat areas have not been designated, and (3) certain actions within the forthcoming critical habitat areas may need approval by the Fish and Wildlife Service (McBryde 1977).

The findings of Watson (1976) were in agreement with the revised threatened and endangered list for the species Silene spaldingii and Trisetum orthochaetum, but reported that Phlox missoulensis, the third species on the revised list of Montana species, was not at the present time either threatened or endangered. He also concluded that Grindelia howellii and Penstemon lemhiensis, which were not on the list, should be included.

Therefore, based on Watson's investigation, only four species are considered at this time as potentially endangered in Montana as they will undoubtedly be on the official list when it is finalized. These four species--Silene spaldingii, Grindelia howellii, Penstemon lemhiensis, and Trisetum orthochaetum--are all found on the western side of the state.

The species Rorippa calycena, known to occur in eastern Montana, was reported by Watson as needing further exploration before its status is determined. Therefore, as this species may potentially be found within the study area, for purposes of this analysis it is considered threatened and all necessary precautions would be taken to preserve this species if it should be encountered. None of the above species are presently known to exist within the proposed or alternative two-mile wide corridors.

POISONOUS AND NOXIOUS PLANTS

There are several poisonous and noxious plants found within the study area. Although these plants do not pose a major problem, livestock operators have occasionally reported livestock losses that are significant to individual operations.

The five most important noxious plants found in the study area are Canada thistle, leafy spurge, dalmatian toad flax, field bindweed, and

Russian knapweed. These species are unpalatable to all classes of livestock. Only under extreme conditions would they ever be eaten even in small amounts. They are invader species that, once established, will compete with desirable forage species for space.

Table III-3 lists the important poisonous plants known to occur in the study area. It should be recognized that many potentially poisonous plants may be harmless under most circumstances. Some of these species are valuable forage for livestock and wildlife. Also, many poisonous species affect all classes of livestock to some degree, but the class that has been checked is most susceptible.

Poisonous and noxious plant control is normally conducted as specified by local Weed Control Districts.

FISH AND WILDLIFE

The Colstrip-Hot Springs study area contains a wide diversity of wildlife habitat, ranging from the semi-arid steppe of the eastern plains to the alpine tundra and montane forest in the western mountains. Nearly all major habitat types, and, consequently, most of Montana's wildlife species, are found within the study area.

General distribution and key areas for important game species are shown on Figures III-10, 11, 12, and 13. The general distribution of a species is defined as the limits of its year-round geographic range. Key areas include breeding grounds, calving grounds, or wintering areas.

Over seven hundred species of vertebrate animals occupy migratory, seasonal, or year-round ranges in Montana. Constraints of time, limited available information concerning habitat requirements, and lack of sufficient detail in habitat inventory preclude complete assessment of impacts for all Montana wildlife. Conflicting habitat requirements of many species further compound the evaluation of alternatives. The description of environment/wildlife focuses on distributions and habitat requirements and is limited to game species, furbearers, predators,

Table III-3 - IMPORTANT POISONOUS PLANTS

	TYPE OF PLANT			HABITAT						POISONOUS PRINCIPLE					MOST DANGEROUS SEASONS						LIVESTOCK AFFECTED			
	FORB	SHRUB	TREE	WASTE AREAS	WET AREAS	VALLEYS	PLAINS	FOOTHILLS	MOUNTAINS	ALKALOID	GLYCOSIDE	OXALATE	SELENIUM	OTHER OR UNKNOWN	SPRING	SUMMER	FALL	WINTER	ALL	UNKNOWN	SHEEP	CATTLE	HORSES	UNKNOWN
Death Camas (*Zygadenus spp.*)	x	-	-	-	-	x	x	x	x	x	-	-	-	-	x	-	-	-	-	-	x	-	-	-
Low Larkspur (*Delphinium bicolor*)	x	-	-	-	-	x	x	-	-	x	-	-	-	-	x	-	-	-	-	-	-	x	-	-
Tall Larkspur (*D. occidentale*)	x	-	-	-	-	-	-	x	x	-	-	-	-	x	-	x	-	-	-	-	-	x	-	-
Lupine (*Lupinus spp.*)	x	-	-	-	-	x	x	x	-	-	x	-	-	-	-	-	x	-	-	-	x	-	-	-
Pointloco (*Oxytropis spp.*)	x	-	-	-	-	x	x	x	x	-	-	-	-	x	x	-	-	-	-	-	-	-	x	-
White Sweetclover (*Melilotus alba*)	x	-	-	x	-	x	x	-	-	-	-	-	-	x	-	-	-	*	-	-	-	x	-	-
Yellow Sweetclover (*M. officinalis*)	x	-	-	x	-	x	x	-	-	-	-	-	-	x	-	-	-	*	-	-	-	X	-	-
Ponderosa Pine (*Pinus ponderosa*)	-	-	x	-	-	-	x	x	x	-	-	-	-	x	x	-	x	x	-	-	-	x	-	x
Greasewood (*Sarcobatus vermiculatus*)	-	x	-	-	-	x	x	-	-	-	-	x	-	-	x	-	-	-	-	-	x	x	-	-
Milkweed (*Asclepias spp.*)	x	-	-	x	-	x	x	-	-	x	x	-	-	x	x	x	-	-	-	-	x	-	-	-
Milkvetch (*Astragalus spp.*)	x	-	-	-	-	x	x	x	x	-	-	-	x	x	x	x	-	-	-	x	-	x	x	-
Water Hemlock (*Cicuta douglasii*)	x	-	-	-	x	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	x	-	-
Poison Hemlock (*Conium maculatum*)	x	-	-	x	-	x	-	-	-	x	-	-	-	-	x	-	-	-	-	-	x	x	x	-
Halogeton (*Halogeton glomeratus*)	x	-	-	x	-	x	x	-	-	-	-	x	-	-	-	-	x	x	-	-	x	x	-	-
Chokecherry (*Prunus virginiana*)	-	x	x	-	-	x	-	x	x	-	x	-	-	-	x	x	-	-	-	-	x	x	-	-

* Troublesome in hay

Source: Cooperative Extension Service, 1977 nongame species of special interest or concern, and endangered and threatened species, as classified by the Montana Department of Fish and Game (Flath 1977) or the U.S. Secretary of the Interior (USDI 1977b). Complete species lists, along with general comments as to distribution and habitat are appended to Flath's (1977) publication. Hoffman and Pattie (1968) contains general distribution maps of non-game mammals.

Montana game species, furbearers, predators, non-game species of special interest or concern, and endangered and threatened species are listed in Appendix A-1. Those species having distributions not confronted by the Applicant's proposal or any alternative corridor are not considered further. The remaining species are described below.

MAMMALS

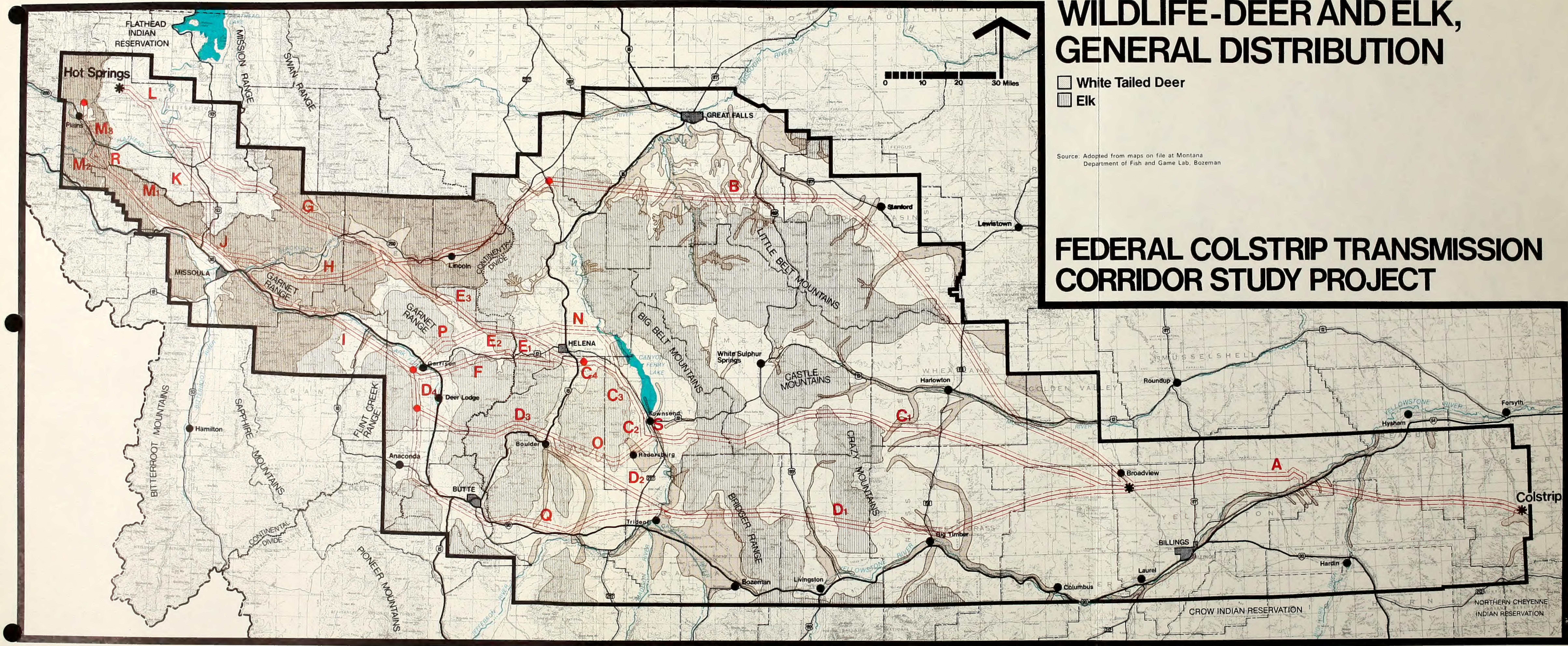
Principal Game Species

Black Bear

Black bears are found in the coniferous forests of the western third of the study area and also in several isolated mountain ranges east of the Continental Divide. They occupy a variety of forest habitats, varying from open ponderosa pine to spruce-fir forests.

Black bears are omnivorous, feeding on a variety of grasses, sedges, forbs, fruits, pine nuts and berries as well as carrion and small mammals. They overwinter in dens, which are usually located beneath large conifer or cottonwood trees at fairly low elevations. Black bears are not true hibernators; they are easily aroused while denning and are often quite active in the den (Wechwerth 1971; Jonkel and Cowan 1971).

Black bears generally avoid clearcut logged areas until dense conifers and shrubs reappear (Jonkel and Cowan 1971), though they make heavy use of road cuts and clearcut edges in early spring, as these are the first areas to "green-up" with succulent forbs and grasses. Black bears are particularly vulnerable to road hunting during this period.



WILDLIFE-DEER AND ELK, GENERAL DISTRIBUTION

▨ White Tailed Deer

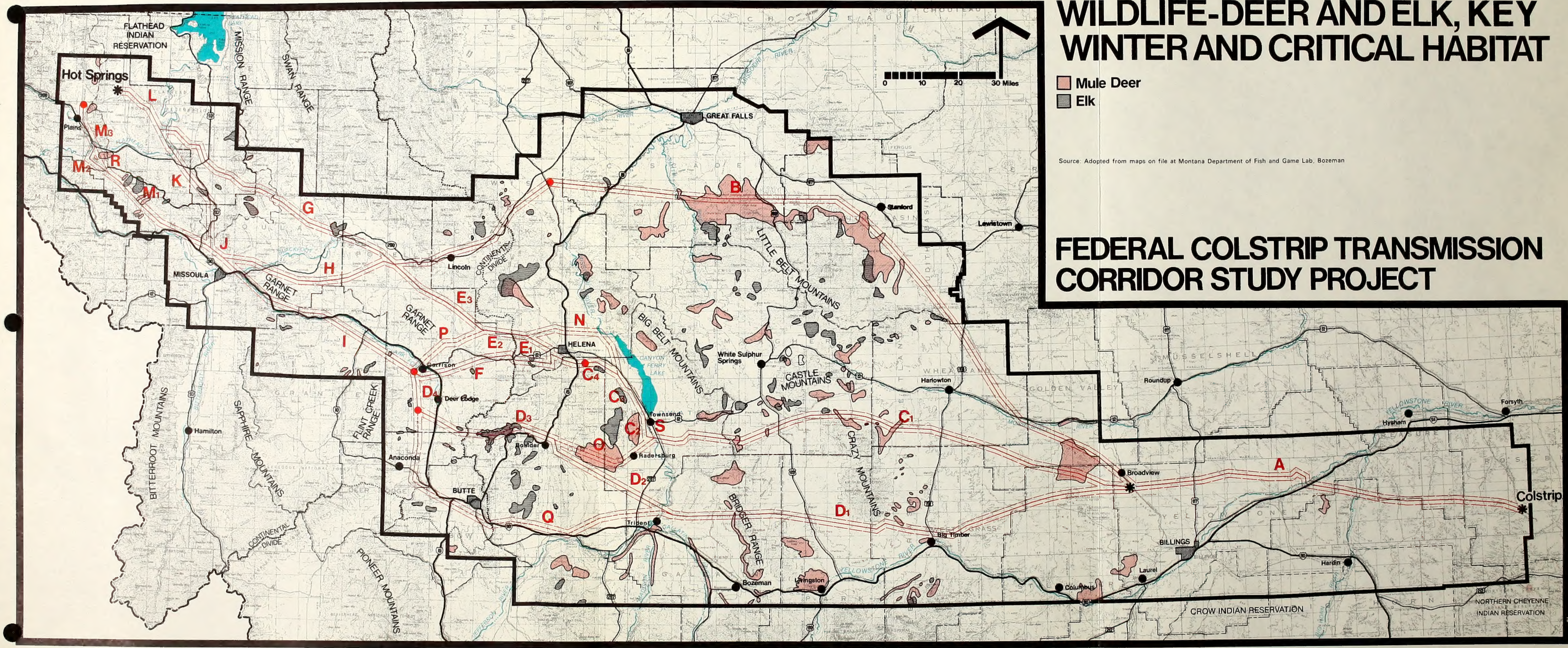
▥ Elk

Source: Adopted from maps on file at Montana Department of Fish and Game Lab, Bozeman

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-10

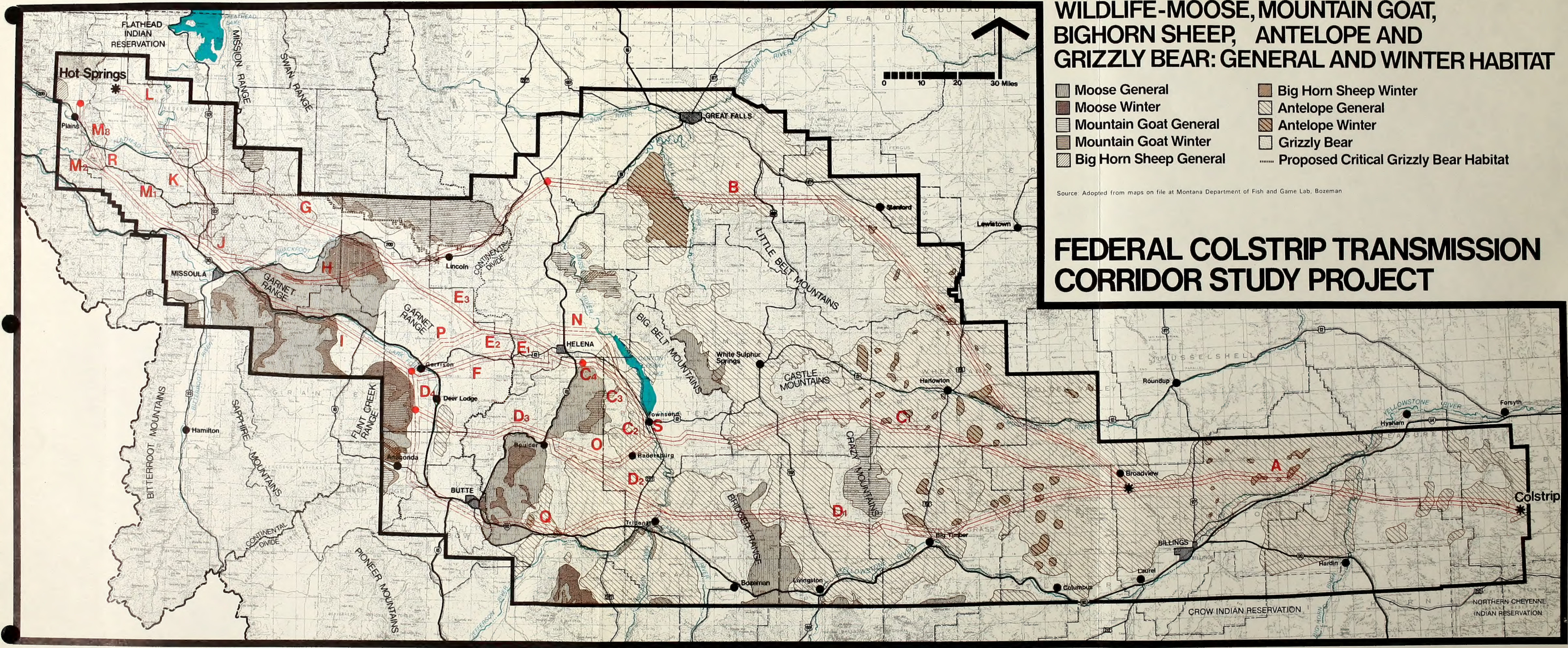
WILDLIFE-DEER AND ELK, KEY WINTER AND CRITICAL HABITAT



Source: Adopted from maps on file at Montana Department of Fish and Game Lab, Bozeman

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-11



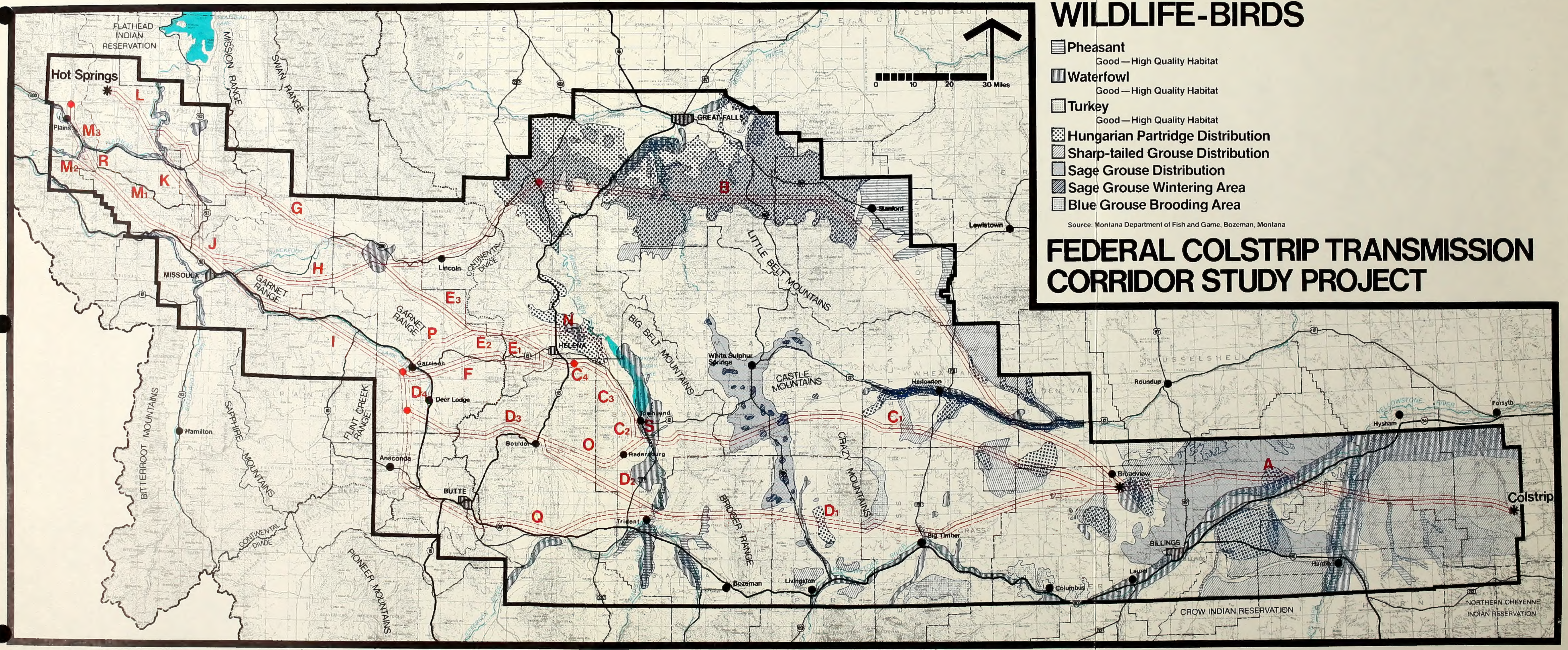
WILDLIFE-MOOSE, MOUNTAIN GOAT, BIGHORN SHEEP, ANTELOPE AND GRIZZLY BEAR: GENERAL AND WINTER HABITAT

- ▨ Moose General
- ▨ Moose Winter
- ▨ Mountain Goat General
- ▨ Mountain Goat Winter
- ▨ Big Horn Sheep General
- ▨ Big Horn Sheep Winter
- ▨ Antelope General
- ▨ Antelope Winter
- ☐ Grizzly Bear
- ······ Proposed Critical Grizzly Bear Habitat

Source: Adopted from maps on file at Montana Department of Fish and Game Lab, Bozeman

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-12



WILDLIFE-BIRDS

- ▤ Pheasant
  Good—High Quality Habitat
- ▥ Waterfowl
  Good—High Quality Habitat
- ☐ Turkey
  Good—High Quality Habitat
- ▩ Hungarian Partridge Distribution
- ▨ Sharp-tailed Grouse Distribution
- ▧ Sage Grouse Distribution
- ▨ Sage Grouse Wintering Area
- ▦ Blue Grouse Brooding Area

Source: Montana Department of Fish and Game, Bozeman, Montana

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-13

Cougar

Cougars are shy and stealthy predators. Rugged timbered and broken timber country of western Montana provides favorable conditions for cougars to stalk the deer and elk which are their principal prey. Much of their rugged home ranges are protected in wilderness and classified roadless areas, but many big game winter ranges cougars hunt are open to multiple use development.

Elk

Elk are distributed through most of the forested mountain ranges of the study area (see Figure III-10). They tend to summer at high elevation, migrating to surrounding foothills, rangelands or valley bottoms to winter. Winter ranges, rutting areas, and calving grounds are displayed on Figure III-11.

Elk prefer native bunchgrasses for winter food (Rognrud and Jansen 1971). However, they are adaptable and will eat other grasses, sedges, forbs and browse. East of the divide, grass ranges are most often used in winter. Important plant species used on these ranges are Idaho fescue, bluebunch wheatgrass, and rough fescue (Knight 1967). In the western portions of the study area which are more heavily forested, browse winter ranges predominate. Major forage plants on these browse ranges are willow, evergreen and redstem ceanothus, mountain maple, serviceberry, chokecherry and sedges (Rognrud and Jansen 1971).

A study of elk along the Dworshak-Hot Springs 500-kV transmission line in northern Idaho demonstrated no significant difference in elk utilization of powerline right-of-way and other forest openings, natural or man-made. Certain findings of the Montana Cooperative Elk-Logging Study Committee (Allen, et al. 1976) are therefore pertinent:

1. Elk prefer small openings, particularly in western Montana, but may accept cutting units as large as 100 acres under some circumstances;

2. Throughout Montana elk range, slash within the opening or the surrounding uncut forest reduces elk use;

3. Where new growth inside an opening consists of both trees and shrubs and elk feed on browse (generally western Montana), elk use of openings increases until vegetation is at least four feet high;

4. Where new growth is mostly trees and since elk feed primarily on grasses and forbs (generally eastern Montana), elk use of openings declines as vegetation height increases. As a corollary, good cover adjacent to the opening is more important on grass-forb elk ranges;

5. Elk on winter range prefer dense timber stands and larger trees for bedding cover. These bedding sites are usually in close proximity to a feeding area such as a south-facing slope with a good stand of browse or perennial grass;

6. During the summer months elk prefer sites at the head of drainages bordering streams or benches. These sites are usually found in the cooler and moister forest associations such as subalpine fir (Payne 1973);

7. During active road-building and logging, elk have responded by moving to surrounding ridgelines and further. Topographic features providing a line of sight barrier appear important. Displacement is considered temporary;

8. Elk travel routes normally cross ridges through saddles. When these saddles are opened up by logging, they tend to be avoided; and

9. In all situations, the size of the opening, vehicle access and available cover are keys to secure use of forage by elk.

Additionally, elk in northwestern Montana make heaviest use of clearcuts in the late fall and early winter, and again in early spring (Biggins 1975). Forage produced on these clearcuts may allow elk to enter the critical winter period with better energy reserves, or provide high quality food to animals having low energy reserves in the spring. Elk show nearly absolute avoidance of clearcuts in western Montana through the summer and fall (Biggins 1975; Marcum 1975), but appear to use clearcuts on summer range to a greater extent in eastern Montana (Allen, et al. 1976).

White-tailed Deer

White-tailed deer are found east of the divide primarily along the Missouri, Musselshell, Shields, and Yellowstone Rivers and their major tributaries. West of the divide white-tailed deer may be found in the river bottoms of the Clark Fork, Blackfoot and Clearwater Rivers, and in closed canopy Douglas fir and ponderosa pine forests. The bottomlands and their associated deciduous vegetation, and the browse beneath heavy conifer stands, are essential to white-tail populations throughout the year. White-tailed deer use of forested habitat is generally in a linear relationship to percent canopy closure (Mundinger 1976). White-tailed deer ranges are displayed on Figures III-10 and 11.

Mule Deer

Mule deer are found throughout the study area, excluding urban areas and mountain tops; for this reason they are not included on Figure III-10. In the more heavily forested areas of western Montana, the deer tend to be migratory, moving to valley bottoms and rangelands in winter. Winter ranges and year long high-density areas are shown on Figure III-11.

Mule deer occupy most habitat types, including pine forests, spruce forests, river bottoms and badlands. Browse is the most important yearlong source of forage (Knoche 1968; Mackie 1970). Important browse species include curlleaf mountain mahogany, bitterbrush, chokecherry, serviceberry, common and creeping juniper, mountain maple, evergreen and redstem ceanothus, big sagebrush, fringed sage, dogwood, and common snowberry. In spring and summer, grasses, forbs, and the leafy portions of palatable browse plants are also important components of mule deer diets.

Mule deer show a more dramatic response to height of vegetation and depth of slash within a clearcut opening than do elk. Optimum opening size for mule deer appears to be 40 acres (Lyon 1975).

Moose

Moose occur in the western half of the study area. General distribution and wintering areas are mapped on Figure III-12. High density moose areas include willow and aquatic areas, montane forests and deciduous forests (Knowlton 1960).

Moose are primarily browsers. At higher elevations dwarf huckleberry, willow, and subalpine fir are the most important browse items in their diet. At lower elevations Douglas fir, dogwood, serviceberry, chokecherry, and willow (where available) comprise the bulk of the diet (Knowlton 1960).

Antelope

The antelope occurs in the eastern two-thirds of the study area. Optimum pronghorn habitat is open sagebrush-grasslands (Compton, et al. 1971). During the summer, antelope may utilize a diversity of habitat types, with concentrations of animals on moist sites located in depressions and/or along creek bottoms. Wintering areas, shown on the Figure III-12, are closely associated with silver and big sagebrush habitat types.

Sagebrush and forbs, especially fringed sage and yellow sweetclover, are essential forage items in the yearlong diet of the antelope (Bayles 1969; Wentland 1968). Shrubs are most important during winter, and forbs most important during the remainder of normal years.

Bison

Bison are limited to a carefully controlled population within the National Bison Range, which is not confronted by the Applicant's proposed or any alternative.

Bighorn Sheep

Bighorn sheep occur in isolated herds in the western half of the study area. Bighorn sheep distribution, as mapped by the Montana Fish and Game and shown on Figure III-12, is not confronted by the Applicant's proposed or any alternative corridor.

Mountain Goats

Mountain goats have been historically absent from several areas of suitable habitat within the study area. Since 1941, mountain goats have been transplanted to the Crazy, Tobacco Root, Highwood, Big Snowy, Elkhorn, Absaroka and Bridger Mountains and to the Gates of the Mountains Wilderness (Foss and Rognrud 1971). Mountain goat distribution is mapped on Figure III-12. Mountain goat range is not confronted by the Applicant's proposed or any alternative corridor.

Principal Furbearing Species

Fisher

The fisher is closely associated with climax spruce-fir forest. It was exterminated from Montana in the late 1920's; re-introductions in 1959 have resulted in small populations in the Holland Lake areas of the Swan Valley and the Rock Creek drainage southeast of Missoula (Mitchell, et al. 1971).

Marten

Marten favor high elevation basins dominated by spruce and alpine fir or mountain hemlock forests. Mature lodgepole pine will occasionally host marten if the stands include moist sites supporting spruce or fir. Though essentially a high country animal, marten will occasionally be found in moist low elevation forests such as cedar-grand fir. Marten rarely visit dry sites forested with ponderosa pine, inland Douglas fir and associated species. Marten overwinter in old growth forests with canopy cover greater than 30 percent, rarely cross openings wider than 300 feet and do not hunt in openings (Koehler, et al. 1975).

Mink

Mink are fairly common along waterways throughout the study area in a wide variety of general habitats as long as a riparian edge is present.

River Otter

River otters are fairly common in western Montana along major rivers, lakes, and ponds, associated with mature riparian or dry coniferous forest (Hoffman and Pattee 1968).

Beaver

The beaver is common along waterways in the study area, building dams on smaller streams, and burrowing into banks on larger streams. Seral riparian shrub and tree communities provide favorable foraging conditions for the beaver.

Muskrat

Muskrats are common in suitable marshes, lakes, streams, and rivers of the study area, and are not dependent on riparian forest.

Principal Predator Species

Weasels

The least weasel is the smallest of the carnivores, and is uncommon to rare within the study area. Its preferred habitat is open forest edge, and the Little Belt Mountains approximate the southwestern limits of its distribution (Hoffman and Pattee 1968).

The short-tailed weasel is common in subalpine coniferous forests in western Montana, but occasions montane forests, alpine tendra and intermontane valleys. It also occurs in grassland and semi-desert areas, but only in association with brushy riparian types (Hoffman and Pattee 1968).

The long-tailed weasel is more common than the short-tailed weasel in intermontane valleys and open montane forest. It may competitively exclude the smaller weasels (Hoffman and Pattee 1968).

Striped Skunk

The striped skunk is a common predator throughout the study area. Its preferred habitat is forest edge, open woodland, brushy grassland, and riparian vegetation.

Coyote

The coyote is a highly adaptable and very common predator found throughout the study area. Its habitat ranges from the moist forest through dry grassland, though it is most common in the drier vegetative types.

Threatened or Endangered Species

Black-footed ferret

Black-footed ferrets were once found in association with prairie dog towns in the eastern half of the study area, but it appears they have become extinct in Montana. The last unconfirmed sighting in Montana dates from 1970 and there have been no confirmed sightings in Montana since 1953 (Snow 1972). The black-footed ferret is presently classified as an endangered species (USDI 1977b).

Wolf

The Rocky Mountain timber wolf is an endangered species (USDI 1977b) of wide-ranging habits. No den sites are presently known in Montana. The most frequent observations come from the Continental Divide country of the "Bob Marshall ecosystem," and Beaverhead County (Flath 1977).

Grizzly Bear

Of an estimated 700 grizzly bears remaining in the coterminous United States, over half are found in Montana (Craighead, et. al. 1972). Within the study area, grizzly bears are known to occur in remote forested areas adjacent to the Mission Mountains and Bob Marshall Wilderness Areas. Although the grizzly bear is classified as a threatened animal by the U.S. Fish and Wildlife Service (USDI 1977b), it is unlikely that their numbers have declined significantly in northwestern Montana in the last several decades (Jonkel, et al. undated). Hunting is presently restricted to the "Bob Marshall ecosystem," with total kill (from all human causes) limited to 25 animals per year.

Grizzly bears are large, wide-ranging omnivores that appear to be behaviorally (Herrero 1972) and nutritionally (Mealey 1975) adapted to open or non-forested areas, though adjacent timbered areas presumably are important as security cover (Knight 1975; Craighead and Craighead 1972).

Grizzlies in northwestern Montana appear to derive most of their energy from the fruits of shrubs. Primary use of these foods occurs between mid-July and mid-October. Burned-over areas, most frequently associated with subalpine fir-beargrass-blue huckleberry habitat types (Pfister 1977), are major producers of these shrubs. Clearcuts which have not been heavily scarified show about the same vegetative composition and apparent value to bears as burned-over areas, though disturbance resulting from unmanaged road use may negate the "habitat improvement" of such man-made openings (Mealey, et al. 1977).

Before and after the seasonal fruits of shrubs are available, grizzlies consume roots and succulent herbs found primarily in avalanche chutes, stream bottoms, wet meadows, side hill parks, roadsides and ridgetops (Mealey, et al. 1977). Carrion, small mammals, and refuse may be opportunistically consumed by these bears. Garbage and "hand-outs" have caused problems by attracting bears around the camps of gas and oil exploration and development crews (Schallenberger 1977).

Most of the more important grizzly bear habitats in northwestern Montana occur above 5800' elevation (Mealey, et al. 1977). Components of early spring grizzly habitat (e.g., Jocko Valley meadows) frequently occur below this elevation.

A "critical habitat" delineation has been proposed by the U.S. Fish and Wildlife Service (1976), pursuant to section 7 of the Endangered Species Act of 1973. The proposed delineation is shown on Figure III-12.

Human-grizzly confrontations have on rare occasion resulted in injury or death to the persons involved, but far more frequently have resulted in injury or death to grizzlies. Reprisals have also destroyed grizzlies not involved in confrontation incidents. Human-grizzly confrontations have increased with increased development, access, and dispersed recreation.

Non-Game Species of Special Interest or Concern

Shrews

The four shrews - Merriam's shrew, dwarf shrew, Preble's shrew and pygmy shrew - have extremely small home ranges and scattered (mostly unknown) populations.

Merriam's shrew is associated with arid sagebrush desert, sagebrush-grass semi-desert, and occasionally dry grassland. Preble's shrew is often found in dry sagebrush and sagebrush grasslands, and the Pygmy shrew favors dry forest edge (Hoffman and Pattee 1968). The dwarf shrew is endemic to alpine habitat types of isolated mountain ranges (Hoffman and Pattee 1968), and is not confronted by the proposed or any alternative corridors.

Bats

The California bat typically roosts in dark man-made structures during the day, in cliff crevices at night, and except for small occasional maternity colonies, does not frequent specific roosts. Maternity colonies of the long-legged bat roost in trees by day, and in caves by night. The fringed bat roosts in colonies in caves, mines and crevices in open ponderosa pine habitats. The spotted bat has been observed only once in Montana and is probably resident (if it occurs at all) of high cliffs and canyons in the ponderosa pine types of the Pryor Mountains. The big-eared bat winters in Lewis and Clark caverns, and summer roosts in scattered buildings.

All five bats are insectivorous. Moths appear to be their principal food item (Barbour and Davis 1969).

Least Weasel

The weasel is discussed under "Principal Predator Species" in this chapter.

Wolverine

Wolverines are rare inhabitants of timbered mountainous regions in the western half of the study area. Preliminary analysis of data from a radio telemetry wolverine study in northwestern Montana suggests that they generally avoid clearcut areas, except for limited activity around the edges, and roads during spring and summer (Hash 1977).

Lynx

Lynx and bobcat are sympatric predators of forested and brushy areas of Montana. Bobcats inhabit a much wider range of vegetative types than do lynx, from desert sagebrush to deciduous and coniferous forests. The lynx range has extended into drier brushy areas of Montana, but is more typically associated with subalpine forest types (Hoffman and Pattee 1968). The bobcat is more favored by intermediate successional stages than the lynx. Both prey on rabbits and rodents, with the lynx preying much more exclusively on rabbits. Populations of these two predators tends to fluctuate with their prey populations.

Hoary Marmot

The hoary marmot is endemic to alpine habitat types not confronted by the Applicant's proposed or any alternative corridor.

Black-tailed Prairie Dog

The black-tailed prairie dog has been reduced to widely scattered colonies in the grassland and sagebrush types east of the Continental Divide.

BIRDS

Principal Game Species

Waterfowl

Several key waterfowl breeding and wintering areas (see Figure III-13) occur within the study area. The Flathead, Clark Fork, Jocko, Yellowstone, and Bighorn Rivers are heavily used by wintering ducks of many species. Ducks and geese also nest along these rivers. Key duck breeding areas include the flats from Big Lake to Acton, Broadview, and Hay Basin, and the lake systems around Browns and Freezeout Lakes.

Other important breeding, nesting, and wintering areas include Pablo and Ninepipes National Wildlife Refuge, Lake Helena and Canyon Ferry Reservoir.

Important waterfowl corridors cross western Montana. Whistling swans pass from Freezeout Lake south into Idaho along a broad corridor east of the Continental Divide. Snow geese stop over at Freezeout Lake, then pass west out of the state along a broad corridor.

Chukar Partridge

Chukar partridge are found in isolated patches in the study area where sagebrush-juniper or sagebrush-bitterbrush interspersed with cheatgrass and bunchgrass occur. These birds appear to have reached their distributional limit in the state.

Hungarian Partridge

Hungarian partridge are scattered throughout the eastern two-thirds of the study area, inhabiting primarily croplands and grasslands. Hungarian partridge distribution is shown on Figure III-13.

Merriam's Turkey

Merriam's turkeys occur primarily in the eastern half of the study area. They are most successful in forests where approximately half of the vegetative cover consists of ponderosa pine, with the remaining components comprised of grasses, deciduous trees, and shrubs occurring in scattered small openings and stream courses throughout the forest. Turkey distribution is shown on Figure III-13.

Blue Grouse

Blue grouse are widespread in the Douglas fir zone in the mountainous western third of the study area. Their winter diet consists primarily of conifer needles, while the summer diet consists of insects, berries, and green plants (Mussehl, et al. 1971). Males establish breeding territories adjacent to the forest edge.

Spruce Grouse

Spruce grouse are found in dense Engelmann spruce and lodgepole pine forests. In winter, they live primarily on conifer needles, and in summer they live on insects, berries, and green plants (Mussehl, et al. 1971).

Ruffed Grouse

Ruffed grouse inhabit dense cover in mixed forests and along stream bottoms in the mountainous portions of the study area. Their winter diet consists of the buds of deciduous trees and shrubs, and their summer diet consists of insects, berries, and green plants (Mussehl, et al. 1971).

White-tailed Ptarmigan

The white-tailed ptarmigan is a scarce inhabitant of alpine tundra, rocky ledges and glacial cirques. Its habitat is not confronted by the Applicant's proposed or any alternative corridor.

Sharp-tailed Grouse

Sharp-tailed grouse occur in the eastern two-thirds of the study area. Their distribution is shown on Figure III-13. Sharp-tailed grouse habitat is characterized by tree-shrub-grasslands located in the upland prairie. Standing grasses, dense trees, and shrubs are needed for food, nesting activities, cover and winter survival (Brown 1971). Breeding occurs at very specific traditional display grounds called dancing grounds.

Sage Grouse

Sage grouse occur in the sagebrush communities of the eastern two-thirds of the study area. Sage grouse distributions are shown on Figure III-13. Sage grouse are highly dependent on sagebrush, primarily big sagebrush, for their existence. It comprises almost 100 percent of their winter diet (Martin and Pyrah 1971). Critical wintering areas are also outlined on Figure III-13. Breeding occurs at very specific traditional display grounds called drumming grounds.

Ring-necked Pheasant

The ring-necked pheasant occurs within the study area in association with irrigated bottom lands, primarily along the Yellowstone and Missouri Rivers and their major tributaries. Pheasants also occur on farmlands near Ninepipes National Wildlife Refuge south of Flathead Lake and west of Lewistown. Pheasant populations are decreasing in the study area (Compton 1973; Watts, et al. 1973), as subdivision, field consolidation and "clean-farming" remove pheasant cover.

Threatened and Endangered Species

American Peregrine Falcon

The American peregrine falcon is an endangered species (USDI 1977b). Although this species is not known to breed in the study area, a few eyries, active within the last five years, are present in Montana (Sumner 1974). Occasional birds can be expected to occur throughout the study area, associated with forest-prairie edge. Potential habitat areas have been identified along segment M_3 (Haynam and Sumner 1977).

Whooping Crane

Although the whooping crane neither breeds nor winters in Montana, occasional individuals may pass over the study area during migration. The whooping crane is an endangered species (USDI 1977b).

Bald Eagle

The northern bald eagle has recently been classified as a threatened species. It requires substantial nesting trees and is closely tied to major water courses throughout its nesting season, feeding principally on fish and waterfowl. It also winters along major river bottoms in Montana, but may range more widely in scavenging for food.

Non-Game Species of Special Interest or Concern

Thirty-nine species of birds have been tentatively identified as being of "special interest or concern." Many of these species are listed only because they are peripheral species in Montana (Flath 1977).

Eagles, Hawks and Falcons

Three accipiters, the goshawk, the sharp-shinned hawk, and the Cooper's hawk, nest in Montana. The goshawk and sharp-shinned hawk occur primarily in coniferous forest while the Cooper's hawk is associated more often with riparian forest. All prefer mature forest canopies (USDA Forest Service 1977).

The ferruginous hawk is a broad-winged hawk of the shortgrass prairie and riparian prairie bottoms.

The golden eagle is a large territorial bird of prey, heavily dependent on rabbits and ground squirrels as a food resource (Baglien 1975; Reynolds 1969; McGahan 1967). It requires open country for hunting, but is most commonly associated with mountain and foothill areas where cliffs or large trees provide the support necessary for their substantial nest structures.

The marsh hawk is a small raptor of the prairies which feeds primarily on field mice.

The bald eagle and osprey are fish eating birds of prey, tied closely by their habits to the major water courses. The osprey is exclusively a fisherman, while the bald eagle also preys on waterfowl and opportunistically consumes carrion.

The prairie and peregrine falcons are discussed above. The pigeon hawk is a small falcon of the prairie and mountain valley bottoms.

The gyrfalcon occasionally winters in Montana during periods of low prey availability or very severe winters in Canada.

Shore Birds

Of eleven species of these shorebirds which are of special interest or concern, only two, the piping plover and the mountain plover are seasonal residents. The other nine are migrants. All are associated with wetland or riparian edges.

Owls

Nine species of owls are of special interest or concern. The snowy owl and the boreal owl are like the gyrfalcon, northern species only occasionally wintering in Montana. The screech owl, pygmy owl, and barred owl are associated with hardwood bottoms of the plains and mountain valley grasslands. The burrowing owl is also associated with plains, but does not require the hardwood bottoms. The great gray, long eared and saw-whet owls are associated with mature Douglas fir and ponderosa pine forests.

Woodpeckers

Three woodpeckers are considered, the Williamson's sapsucker, the black-backed three-toed woodpecker, and the northern three-toed woodpecker. The Williamson's sapsucker is associated with hardwood bottoms, and pole-sized Douglas fir and ponderosa pine forests. The three-toed woodpeckers are associated with moist, mature coniferous forests, and are dependent on snags for feeding and nesting.

Song Birds

The eastern and western bluebirds are residents of mature hardwood bottoms. The dickcissel is a resident of brushy prairie bottoms and windrows.

FISHERIES

Description of fisheries is limited to cold water fisheries on the rationale that if potential impacts fall within acceptable limits for temperature and turbidity sensitive cold water species, other fishes will not be impacted. More complete descriptions of Montana fishes, their distributions and habits are found in Brown (1971). The study area encompasses some of the finest cold water fisheries in the country. These have been ranked as class I, II, III, or IV fisheries by the Montana Fish and Game for their potential productivity and recreational significance (see Figure III-7).

East of the Divide in the Smith River drainage, four species of trout--cutthroat, brook, rainbow and brown--are widely distributed. In addition, mountain whitefish are abundant in this drainage (Wipperman, et al. 1973). The Missouri River system upstream from Great Falls has good populations of rainbow and brown trout. The Musselshell River upstream from Careless Creek also has good populations of brown trout.

The Yellowstone River drainage supports a variety of warm and cold water fish from the Bighorn River to Big Timber. The upper Yellowstone drainage above Big Timber supports brown, rainbow, and cutthroat trout, and mountain whitefish.

Five species of trout, including cutthroat, brook, rainbow, brown, and Dolly Varden, occur west of the Divide. The Blackfoot River drainage has good populations of brown, rainbow, cutthroat, and Dolly Varden trout. Brook trout also occur in some tributaries of this river system. Kokanee salmon occur in portions of the Clearwater drainage. The Jocko River near the Divide contains westslope cutthroat. The Clark Fork River has good populations of brown, rainbow, and cutthroat trout.

The arctic grayling, a cold-water stream fish, was once common in the Missouri River drainage above Great Falls. Today relict and transplanted populations exist in only a few lakes and streams within the study area. The decline in numbers of this species has been due in part to the change in habitat resulting from logging, mining, and overgrazing, as well as competition from other species (Brown 1971).

All of the Montana salmonids (trout species) require clean spawning gravels for the development of young from eggs. The mountain whitefish, kokanee, brown trout, brook trout, and Dolly Varden are fall spawners. The cutthroat trout, rainbow trout, and arctic grayling are spring spawners.

No threatened or endangered species are known to occur in the study area.

REPTILES

Reptiles of special interest or concern (Flath 1977) are the snapping turtle, the spiny softshell, the milk snake and the plains hognose snake. The snapping turtle occupies slow or still waters in eastern Montana; the spiny softshell is found in southeastern Montana rivers. The plains hognose snake occurs in sand and gravel areas of eastern Montana; the milk snake occurs in a variety of southern Montana habitats.

No threatened or endangered species are known to occur in the study area.

AMPHIBIANS

Three amphibians identified as being of special interest or concern, occur within the study area: the Pacific giant salamander, tailed frog and bull frog (Flath 1977). All three are restricted to water and riparian edge areas.

No threatened or endangered species are known to occur in the study area.

LAND USE

AGRICULTURE

Agriculture is Montana's biggest industry with the state's annual farm income surpassing one billion dollars (MDASRS 1976). The total land area occupied by farms in the state is over 63 million acres, and approximately one-fourth of this (15.4 million acres) is cultivated agricultural cropland.

The four major factors of agricultural production are land, labor, capital and technology (MAESCES 1973). Each of these may be influenced to some extent by the installation of a power transmission line across a farm, but land taken out of production is the most important factor. To properly assess the impact of each proposed corridor segment on the agricultural production of an area, a reliable estimate of land values and annual crop production income must be made. Because the value of agricultural land is closely related to its production capacity, both of these items can be analyzed on the basis of productivity. Further, productivity is dependent largely on the water supply in this semi-arid region. As a result, two major categories of productivity exist under Montana conditions; 1) that related to irrigated land areas and 2) that related to non-irrigated cropland (see Figure III-14). A third category would include any particularly high-value or unique farmland. Each of these categories of land is suited to specific agricultural pursuits which influence the crop value and the land value itself. The general situation, both environmental and economic, of these three categories is addressed in the following discussion. Rangeland is not included under Agricultural land as it was considered separately in this study.

Prime and Unique Farmlands

To evaluate the impact of a power corridor across agricultural lands, it is necessary to give special consideration to any lands that would be of particularly high value due to some "prime" or "unique" characteristics. According to Federal standards, prime and unique farmlands are described in the USDA Soil Conservation Service "Land Inventory and Monitoring" memo 3, revision 1, August 16, 1977. States have the right to refine these standards for in-state use. This has not been done at this time in Montana, and no map of prime and unique farmlands of the state has been developed. Lands surrounding Flathead Lake which are suited for cherry orchards are examples of unique farmlands but none of the proposed segments impinge upon these lands.

Within the corridor study area, certain agricultural lands may be considered prime land due to inflated real estate values. Their increased value is a result of factors other than current agricultural production capacity, such as urbanization or recreation and second home development sites. The influence of these factors on the overall impact of a power corridor is accounted for in the discussions of other resources. Therefore, agricultural land values are based on their productivity capacities, rather than on the actual market price they may demand due to potential non-agricultural uses.

As a result of this productivity capacity approach, plus the fact that no state or Federally designated areas of prime and unique farmlands are located within the corridor study area, no special consideration is required for this land category.

AGRICULTURAL LANDS

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

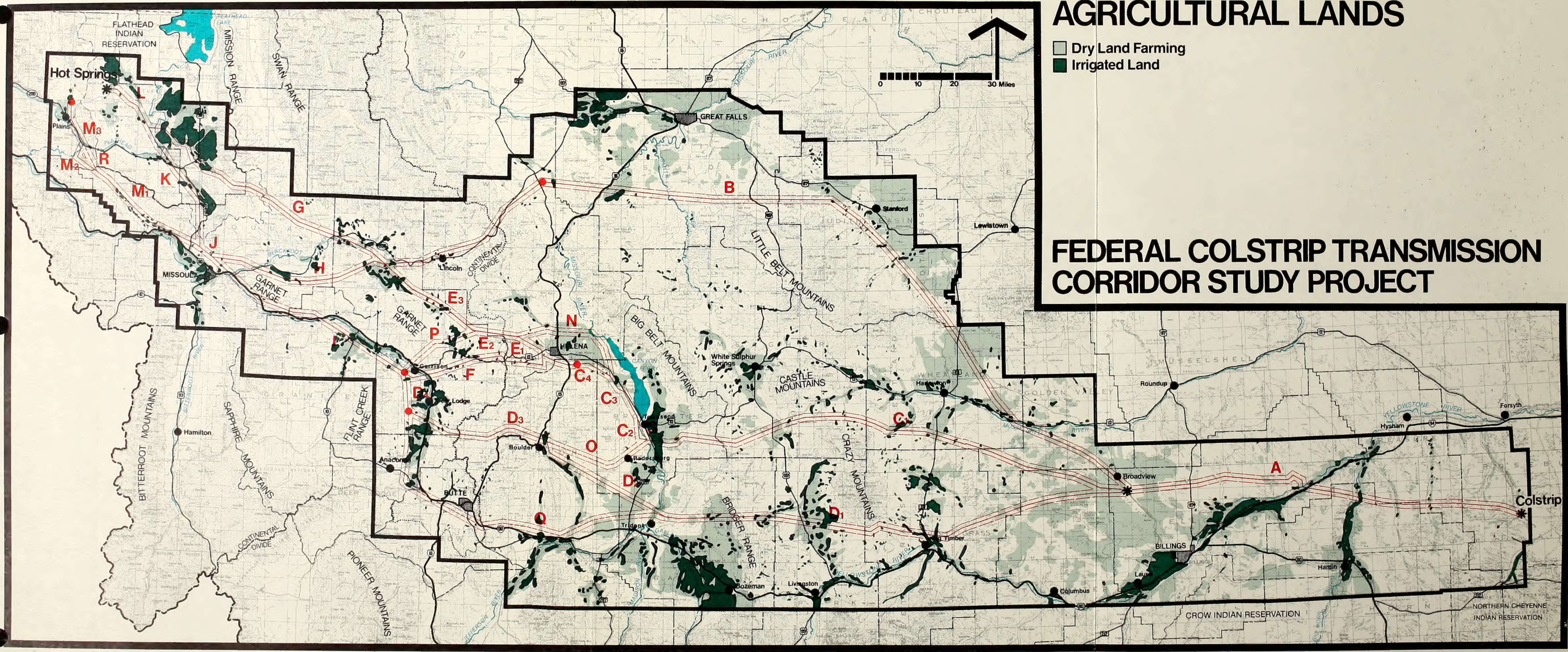


Figure III-14

Irrigated Croplands

Approximately 20 percent of the harvested crop acreage of Montana is irrigated land (about 1.8 million acres), and nearly a third of the value of crop production is derived from these lands. Within the study area, these proportions for irrigated land are somewhat higher, because several major irrigation projects lie within the study area while the largest concentrations of non-irrigated lands are outside of the area (see Figure III-14).

Irrigated croplands of Montana occur mainly in three different settings. First, there are the large irrigation project developments that cover broad expanses on major river flood plains and low terraces. These areas have a high concentration of irrigated land with few interspersed rough areas or dryland cropping fields. The water supply is reliable, allowing full season irrigation. Most of the soils have good to excellent physical conditions for irrigation, and their fertility status is readily maintained through normal management programs. Generally, these lands are capable of producing the highest value crops per acre of any lands in the state.

Crops commonly grown are corn, potatoes, sugar beets, dry beans, forage grasses and legumes. Malting barley and other cereal grains are also produced in some areas. No broadly applied crop rotation system has been developed, but the most productive soils will often be devoted to a high value cash crop and the less productive areas will often be used to grow perennial forages.

The second setting of irrigated lands are those located nearer to headwaters and along tributaries of primary streams. Flood plains and level terraces along these streams are irrigated, with much interspersed higher and rougher land. Average field size is generally smaller and the irrigated land much less concentrated than in the large irrigation projects. Full season irrigation is often impossible due to inadequate water distribution systems or low summer stream flow. Soil characteristics are mostly adequate for irrigation, but some marginal soils are included.

Because of these limitations, plus a shorter growing season, productivity on these lands is less than on the large developments.

Forage, including irrigated pastures and hay, is the primary crop produced on these lands. The cropping system consists of continuous forage, with an occasional cereal crop grown during a year of land preparation and reseeding to another crop of perennial forage. Irrigated pastures are used for supplemental grazing in early spring and late fall, as a livestock enterprise is usually a part of the farming operation in these areas. One or two cuttings of hay are taken from the haylands, depending on the elevation and growing season length. The hay is used for winter feeding or sold as a cash crop.

Production on these lands can be increased by conversion from crude gravity irrigation systems to more efficient sprinkler irrigation and adequate soil fertilization. Many farmers in the area are converting to these improved management systems.

The third setting of irrigated land consists of widely dispersed irrigated fields among non-irrigated tracts of agricultural land and rangeland. Most of these are in the western intermountain areas of the study area, with some in the central portion. The potential yield of much of this land is limited by unsuitable terrain, poor soil conditions, inadequate water supply, and a short growing season. The cropping system is basically continuous forage, but most often the hay land or pasture remains in natural or invader species rather than being seeded to improved higher yielding species. The returns per acre are lowest with this type of irrigation situation, but production can be improved by seeding high yielding species, proper fertilization and other intensified management practices.

To determine the potential economic impact of crossing irrigated lands with a power transmission line it is necessary to have a reliable estimate of land values and agricultural production income. A detailed county-by-county analysis of land values for areas in each of the above described irrigated land settings was reported by Hehn (1973). This analysis was based on a procedure for estimating land values according to its actual agricultural productivity (Quenemoen and Thompson 1965), providing the type of information needed to study impacts on agriculture, per se.

Values derived from this type of analysis depend on commodity prices, both those received for products and those paid for production commodities. Examples of annual fluctuations in prices received by farmers are presented in Table III-4. The general trend of prices received is upwards, but large variations between average yearly prices are obvious. Further variations occur on a daily basis.

Table III-4 - PRICES RECEIVED FOR FARM PRODUCTS, 1971 - 1976

Crop	Average Annual Price Received						
	1970	1971	1972	1973	1974	1975	1976*
Winter Wheat ($/bu)	1.23	1.29	1.43	2.99	4.30	3.41	3.09
Spring Wheat ($/bu)	1.41	1.35	1.52	2.95	4.64	4.05	3.76
Barley ($/bu)	0.70	0.87	1.00	1.74	2.45	2.32	2.07
Hay ($/T)	22.32	23.66	30.78	44.46	52.75	44.33	42.50
Potatoes ($/cwt)	2.83	3.15	5.05	10.80	4.95	6.60	-
Sugar Beets ($/T)	17.37	17.20	19.81	37.66	54.74	33.34	-

*First 8 months only.

Another uncertainty in this approach is yearly variation in productivity. Table III-5 presents average statewide yields of selected farm products between 1970-1975. Again, the general long-term trend is upwards, but weather and growing conditions influence yields from year to year.

Table III-5 - YIELDS OF FARM PRODUCTS, 1971 - 1975

Crop	Statewide Average Yield					
	1970	1971	1972	1973	1974	1975
Winter Wheat (bu/A)	27.0	30.0	27.0	26.5	29.5	35.0
Spring Wheat (bu/A)	23.5	23.0	26.0	21.0	19.0	25.5
Barley (bu/A)	38.0	35.0	37.5	30.0	29.0	39.0
Hay (T/A)	1.67	1.64	1.73	1.67	1.78	1.84
Potatoes (cwt/A)	205.0	180.0	220.0	215.0	250.0	230.0
Sugar Beets (T/A)	16.2	19.6	18.6	19.8	18.7	17.1

Due to these fluctuations in prices and yields, land value estimates based on productivity provide only a guideline to actual values. However, they can provide reasonably accurate estimates of differences among land parcels for any given time.

One additional input for this estimate of land values is the cost of production. Comparing prices received for products with prices paid for commodities used in production reveals that the latter increased considerably more than the former during the 1971-1976 period. On a production per unit basis, prices received for all farm commodities as a group increased 54 percent. The long-term increase in yield amounted to 11.4 percent for the crops listed in Tables III-4 and III-5, as an average. Thus, income over this period increased about 60 percent. This compares with an increase in prices paid for production commodities of 76 percent during the same period.

Estimating land values by the "income approach" described by Quenemoen and Thompson (1965) with figures adjusted to account for the changes in prices and costs, gives essentially the same results as those quoted by Hehn (1973). These range from about $130 per acre for the poorest producing irrigated lands to about $510 per acre for the highest producing irrigated lands of the large project developments.

It must be realized that these values are useful as comparative figures between land classes or parcels, but they cannot be considered as the actual market value. Factors such as population growth, pride of ownership, improved production technology and management, speculative considerations for development purposes, and tax regulations often have large influences on the actual market value of specific parcels of land.

Loss of production income for land idled during the construction phase of the powerline must also be considered. During this period, some land would be removed from production for at least one season, with some possibly longer lasting reductions which may result from soil compaction or disturbance from construction activities. Table III-6 presents the approximate dollar value per acre of irrigated crop based on the most recent data (1975) available (MDASRS 1976). These statewide average values are useful only as a guideline. Yields and per acre crop values vary widely around this value for individual producers, or even between fields of the same producer. The actual value for each production unit can be readily determined by using current figures for production and prices received. Production costs saved while these lands are idled during construction could also be accounted for.

Table III-6 - DOLLAR VALUE PER ACRE OF IRRIGATED CROPS, 1975

Irrigated Crop	Statewide Average Yield Per Acre	Price Received Per Prod. Unit	Crop Value Per Acre
Winter Wheat	54.9 bu	$3.41	$187
Spring Wheat	44.1 bu	4.05	179
Corn (silage)	17.0 tons	14.50	246
Corn (grain)	73.0 bu	2.75	201
Oats	59.8 bu	1.45	87
Barley	56.3 bu	2.32	131
Sugar beets	17.1 tons	33.34*	570
Dry beans	16.0 cwt	16.30	261
Potatoes	230.0 cwt	6.60	1,518
Alfalfa hay	2.8 tons	50.00	138

*Includes government payments

Non-Irrigated Croplands

About 80 percent of the harvested crop acreage and two-thirds of the value of crop production in Montana are derived from non-irrigated (dryland) croplands. The dryland cropping areas occur on broad uplands, terrace benches, and alluvial fans which are dissected by drainage systems of various stages of development and roughness (see Figure III-14). A livestock enterprise is a customary part of most dryland farming units within the study area.

The primary crops grown are winter wheat, spring wheat and barley (both for malting and feed). Occasionally, oats, rye or flax are grown on small acreages. The basic cropping pattern includes summer fallow on an alternate year basis, or 1 year of a 3-year rotation. Barley is sometimes seeded in the year following a wheat crop, resulting in a wheat-barley-fallow 3-year rotation. The current trend is toward more continuous cropping, using summer fallow only as required during dry years or to control weeds. Many sprinkler irrigation systems are being installed on some of the better dry croplands which border streams or where groundwater for irrigation can be tapped.

An important component of a successful dry land cereal production operation is the massive equipment which allows farming of large acreages with a minimum of manpower. Wide spans of machinery are employed for tilling and seeding operations, and even the headers on harvesters exceed 24 feet in width. Where strip cropping is practiced, as it is in much of the more concentrated dryland farming areas, the machinery span is designed to conform with the width of strips. Any obstruction impeding the forward motion of the machinery would be costly to the operator. Also, due to the size of the equipment, it would not be possible to cultivate beneath guy wires or towers.

Estimating land values for these non-irrigated croplands in the manner described for irrigated lands (based on crop production capacity) provides a range of values from about $90 per acre to about $200 per acre. Again, it is emphasized that other factors may greatly alter these values.

The per acre values of crop production under dryland conditions of Montana are presented in Table III-7. Again, these average values for dryland provide only a general idea, with accurate values being derived by substituting the actual yield and current price received per unit of production for any given producer or field.

Table III-7 - DOLLAR VALUE PER ACRE OF NON-IRRIGATED CROPS, 1975

Crop	Statewide Average Yield Per Acre	Price Received Per Prod. Unit	Crop Value Per Acre
Winter wheat	34.9 bu	$3.41	$119
Spring wheat	24.8 bu	4.05	100
Barley	36.0 bu	2.32	83
Oats	39.1 bu	1.45	57
Corn (silage)	5.5 tons	14.50	80
Hay	1.4 tons	42.50	60

URBAN/RESIDENTIAL

Only a very small part of the study area is urbanized. In 1967, one percent of the total acreage in the twenty-five county study area was considered "urban and built-up" by the Montana State Division of Research and Information (see Table III-8). Because the western counties of the study area have a larger population than the eastern counties, the urban acreage percentage is higher for the west counties. The more concentrated areas of residential land use are near incorporated cities and along major highways (see Figure III-15).

Comprehensive land use planning within the Colstrip transmission corridor study area is incomplete. Several counties and cities have produced plans, others are working on them, and some have zoning plans. The common goals of these plans are to preserve the perceived quality of life in the planning area and to encourage urban-residential growth in an efficient, easily serviced form. Most of the plans do not specifically discuss the location of high voltage transmission lines. The compatability of line routing with the plans must be deduced from the general goals and objectives of the plans.

RECREATION

Montana is essentially an "outdoor state" with few metropolitan areas and a great deal of open space and beautiful scenery. Many factors

Table III-8 - URBAN AND BUILT-UP AREAS*

EAST COUNTIES	TOTAL LAND AREA (acres x 1000)	URBAN AND BUILT-UP		WEST COUNTIES	TOTAL LAND AREA (acres x 1000)	URBAN AND BUILT-UP	
		(acres x 1000)	%			(acres x 1000)	%
Rosebud	3,220.5	5.2	0.2	Park	1,681.3	18.9	1.1
Treasure	629.8	4.1	0.7	Gallatin	1,610.9	20.1	1.2
Big Horn	3,217.6	11.9	0.4	Madison	2,259.2	11.1	0.5
Yellowstone	1,686.4	44.3	2.6	Jefferson	1,056.6	11.3	1.1
Musselshell	1,207.0	14.1	1.2	Cascade	1,701.8	40.0	2.4
Golden Valley	753.7	7.0	0.9	Lewis & Clark	2,218.2	20.7	0.9
Stillwater	1,150.1	10.4	0.9	Powell	1,495.7	14.1	0.9
Sweet Grass	1,181.4	7.6	0.6	Silver Bow	458.2	13.3	2.9
Wheatland	910.1	5.8	0.6	Deer Lodge	472.3	19.9	4.2
Judith Basin	1,203.2	9.8	0.8	Granite	1,109.1	6.2	0.6
Meagher	1,506.6	7.0	0.5	Missoula	1,672.3	18.0	1.1
Broadwater	766.7	8.8	1.2	Lake	960.0	19.1	2.0
				Sanders	1,792.3	14.2	0.8

*Montana Department of Community Affairs, 1975.

combine to give Montana's outdoor recreation a distinct quality, justifying the state's position as a major national attraction for a rapidly increasing number of visitors MDFG 1973). In spite of the energy problems facing this country, recreationists gave Montana its biggest travel year in 1977 and will likely make 1978 even bigger (Gilluly 1977).

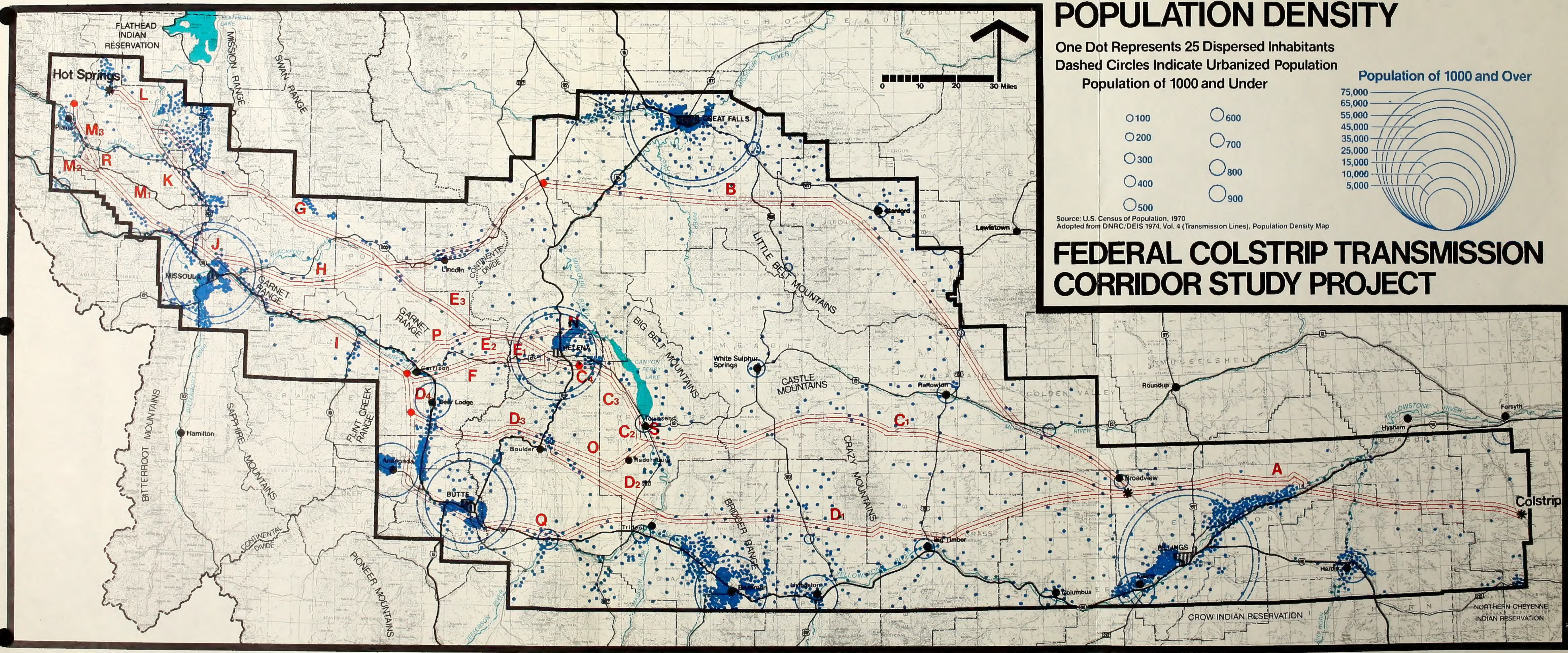


Figure III-15

From the standpoint of scenic topographic features, Montana is most fortunate. The rugged Rocky Mountain system dominates the western half of the study area. Intermingled canyons and valleys hold clear, cold streams, rivers, and lakes. The majority of National Forest lands occur in the mountainous section of the study area and provide many opportunities for scenic drives, camping, picnicking, hunting, fishing, and nature photography. Wilderness hikes and pack trips are important recreational activities also. More people are visiting old "ghost towns," where they discover remnants of a colorful epoch of Montana's past. Cross country and downhill skiing, skating, ice fishing, and snowmobiling are among the popular winter sports.

Eastward, the mountains give way through foothills to rolling prairies and rugged breaks and badlands along the rivers and stream courses. The Missouri, Yellowstone, and Musselshell Rivers dominate this part of the study area. Here the vivid history of the livestock industry lingers with the ranches and open range lands of today. The symmetrical patterns of grain fields stretch to the horizon, adding charm and scenic variety to this portion of the state. River trips, horseback riding, scenic drives, nature photography, rock hounding, farm and ranch vacations, river, lake, and reservoir fishing, spectacular hunting opportunities in the fall, as well as skating and informal snow play during the winter months are among the outdoor activities enjoyed in the spaciousness of eastern Montana. Public domain lands, administered by the Bureau of Land Management, are widely scattered throughout this region adding opportunities for recreational enjoyment (MDFG 1973).

Recreation Area Preferences

According to a 1971-72 statewide survey of Montana residents conducted by the Montana Department of Fish and Game (MDFG), the first preference of the Montana resident is to recreate in natural undeveloped areas such as backcountry areas of the National Forests or other public land areas where there is a minimum of facilities, few people, and little in the way of "controls." The Montana recreationist, according to the survey, prefers above all else those areas where he has lots of "freedom to roam" and an abundance of recreational opportunities (MDFG 1971-72; see Figure III-16).

As a second choice, Montanans prefer the more intensively developed outdoor recreation areas such as state parks and recreation areas, forest recreation areas, and public and private campgrounds. Figure III-17 shows the principal existing recreation sites and areas in the study area.

Recreation Activity Preferences

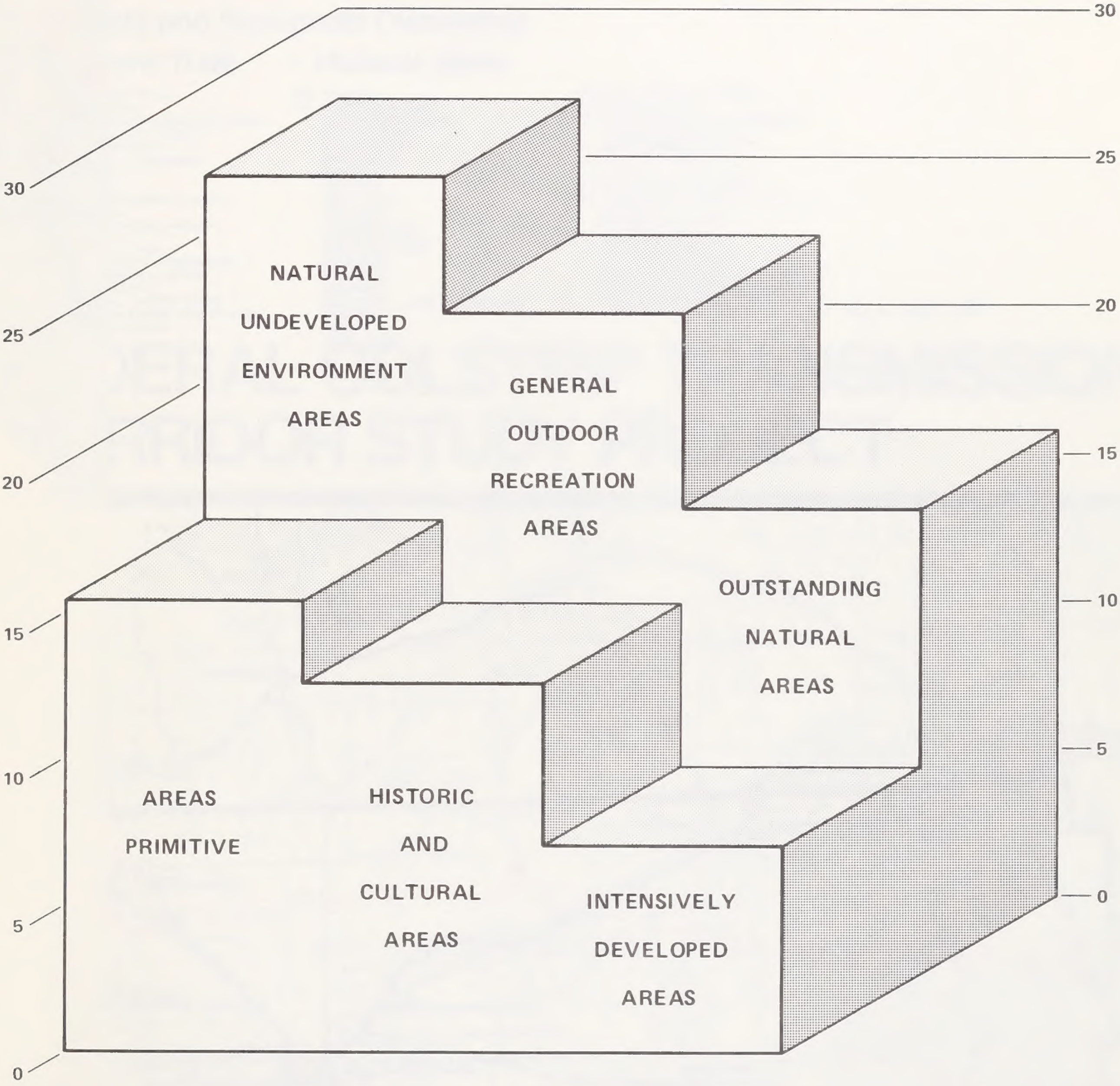
The above survey also shows that driving for pleasure is the most popular outdoor activity, accounting for a statewide average of 18.4% of all time spent engaged in outdoor recreation pursuits. Walking for pleasure is the second most popular activity, accounting for 11.3% of all participation in recreational acivities. Sightseeing accounts for 9.3% of all recreation time and represents the third most popular activity. Fishing is by far Montana's most popular water-oriented activity and the state's fourth most popular activity overall, accounting for 7.4% of all recreation time. Backcountry touring, generally with a four-wheel drive vehicle, is the fifth most popular statewide recreation activity, accounting for 5.6% of all recreation time. It reaches a peak in the autumn and undoubtedly is related to hunting. These five activities account for slightly more than half, 52.1%, of all the time spent in various outdoor recreational activities in Montana. Automobiles or related vehicles are used in three of the activities, accounting for three-fifths of the 52%. Snowmobiling is the most popular winter activity, followed by snow skiing, sledding, and ice skating (MDFG 1973; see Figure III-18).

Figure III-19 shows the potential recreation sites and areas identified within the study area.

RIGHTS-OF-WAY

The following discussions have been compiled directly from the Westinghouse Report (WESD/AEA 1973) and the State of Montana DEIS (DNRC/DEIS 1974).

PREFERENCES FOR SELECTED TYPES OF RECREATION AREAS BY MONTANA RESIDENTS YEARLY TOTAL

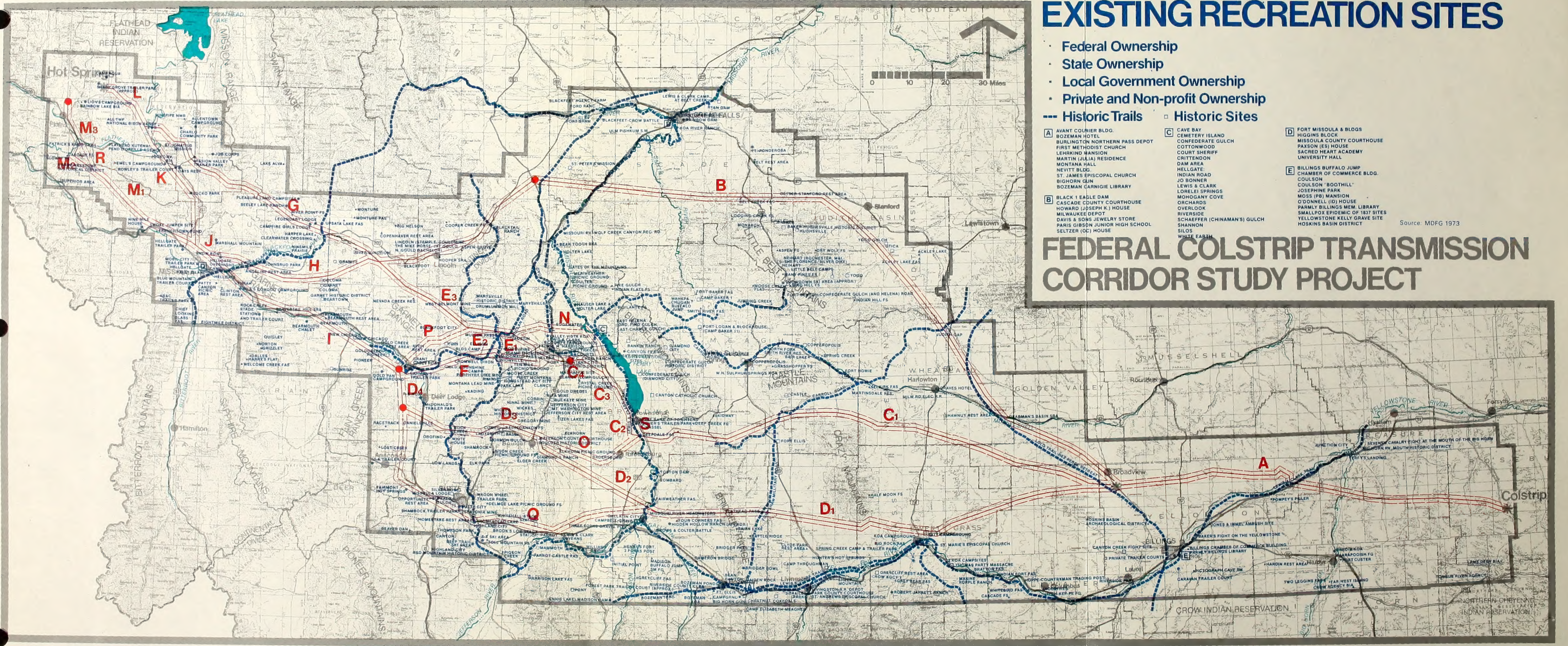


Numbers indicate a weighted percent based on the number of responses to first, second and third preferences.

Source: MDFG 1973

Figure III-16

EXISTING RECREATION SITES



- Federal Ownership
- State Ownership
- Local Government Ownership
- Private and Non-profit Ownership

--- Historic Trails

▫ Historic Sites

A
AVANT COURIER BLDG.
BOZEMAN HOTEL
BURLINGTON NORTHERN PASS DEPOT
FIRST METHODIST CHURCH
LEHRKIND MANSION
MARTIN (JULIA) RESIDENCE
MONTANA HALL
NEVITT BLDG.
ST. JAMES EPISCOPAL CHURCH
BIGHORN GUN
BOZEMAN CARNIGIE LIBRARY

B
BLACK 1 EAGLE DAM
CASCADE COUNTY COURTHOUSE
HOWARD (JOSEPH K.) HOUSE
MILWAUKEE DEPOT
DAVIS & SONS JEWELRY STORE
PARIS GIBSON JUNIOR HIGH SCHOOL
SELTZER (OC) HOUSE

C
CAVE BAY
CEMETERY ISLAND
CONFEDERATE GULCH
COTTONWOOD
COURT SHERIFF
CRITTENDON
DAM AREA
HELLGATE
INDIAN ROAD
JO BONNER
LEWIS & CLARK
LORELEI SPRINGS
MOHOGANY COVE
ORCHARDS
OVERLOOK
RIVERSIDE
SCHAEFFER (CHINAMAN'S) GULCH
SHANNON
SILOS
WHITE EARTH

D
FORT MISSOULA & BLDGS
HIGGINS BLOCK
MISSOULA COUNTY COURTHOUSE
PAXSON (ES) HOUSE
SACRED HEART ACADEMY
UNIVERSITY HALL

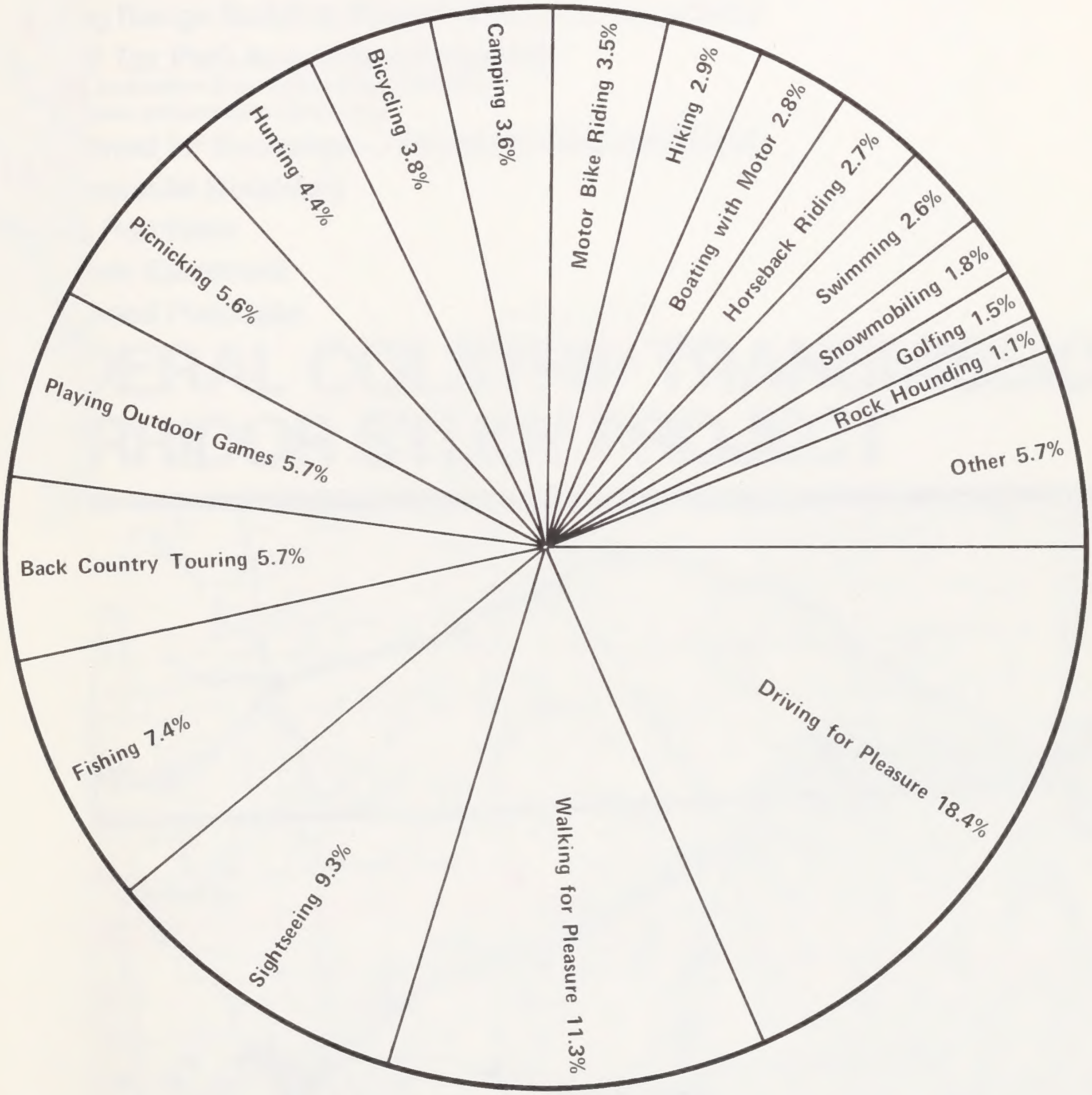
E
BILLINGS BUFFALO JUMP
CHAMBER OF COMMERCE BLDG.
COULSON
COULSON "BOOTHILL"
JOSEPHINE PARK
MOSS (PB) MANSION
O'DONNELL (ID) HOUSE
PARMLY BILLINGS MEM. LIBRARY
SMALLPOX EPIDEMIC OF 1837 SITES
YELLOWSTONE KELLY GRAVE SITE
HOSKINS BASIN DISTRICT

Source: MDFG 1973

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-17

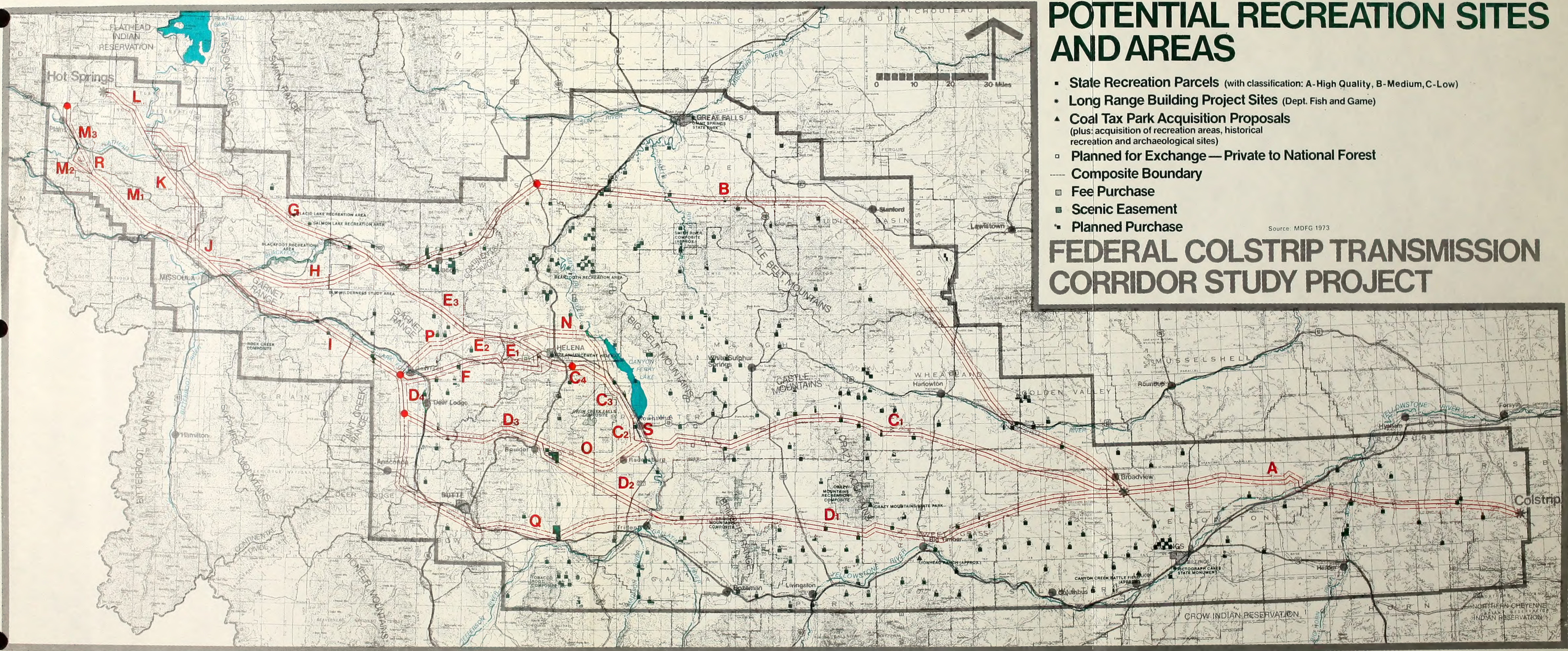
FREQUENCY OF PARTICIPATION IN SELECTED OUTDOOR RECREATION ACTIVITIES BY MONTANA RESIDENTS – YEARLY AVERAGE



The above percentages represent an activity's portion of all recreation time.

Source: MDFG 1973

Figure III-18



POTENTIAL RECREATION SITES AND AREAS

- ▪ State Recreation Parcels (with classification: A-High Quality, B-Medium, C-Low)
- * Long Range Building Project Sites (Dept. Fish and Game)
- ▲ Coal Tax Park Acquisition Proposals (plus: acquisition of recreation areas, historical recreation and archaeological sites)
- ▫ Planned for Exchange — Private to National Forest
- ---- Composite Boundary
- ▨ Fee Purchase
- ■ Scenic Easement
- ▪ Planned Purchase

Source: MDFG 1973

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-19

The present pattern of major transportation corridors in the study area emerged relatively early in the history of Montana. In the days of homesteading and settlement, immigration into the region was primarily from eastern population centers, notably Minneapolis-St. Paul, Chicago, and St. Louis. During this period, topographic features were of prime importance in channeling movements of men across the continent.

The early east-west transportation routes tended to follow river valleys, notably those of the Lower Missouri and Yellowstone, where the topography is relatively flat. In the mountainous western regions of the study area, early roads were restricted to valleys and lower mountain passes. Population centers developed along these early major corridors, especially in the eastern portion of the study area where nearly all major cities and towns are located along the Yellowstone River. The present pattern of transportation corridors strongly reflects this historic development.

Highways

Portions of Interstate Highway 90 follow the most important east-west corridor in the study area. The corridor parallels the Yellowstone River west to Livingston, then continues northwestward through Bozeman, Butte, and Deer Lodge to Missoula. Two major north-south highways cross the study area; these are Interstate 15, which connects Dillon, Butte, Helena, and Great Falls, and U.S. 93, which follows the Bitterroot Valley northward from Lost Train Pass through Hamilton and Missoula, and continues north to Kalispell. These routes and other Federal, state, and county roads are shown on Figure III-20. Unsurfaced and primitive roads are also shown, as they are important in providing construction and maintenance access to the proposed transmission line, even though they are not maintained and are impassable much of the year.

The Westinghouse Report contains a study of traffic counts on major highways in the study area.

Railroads

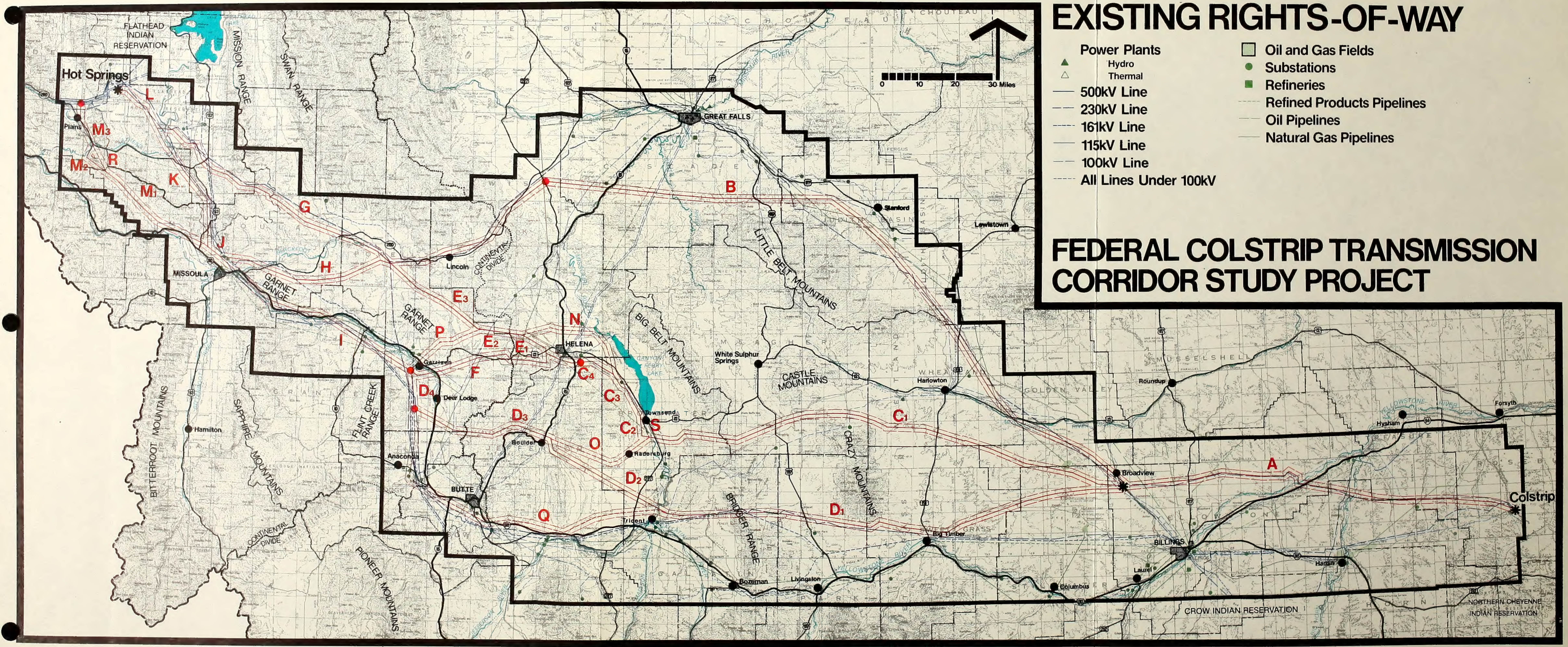
Railways are subject to stricter topographic constraints than are highway alignments. Railroad corridors built along the easier routes have been paralleled by highways throughout much of the study area, but in many instances the two diverge and follow separate routes because of topography and space limitations. Freight lines in particular are not as intimately connected with minor population centers as are highways. The major freight railway in the study area is the Burlington-Northern main line, which is followed closely by I-90 and I-94. This line has branches from Billings to Great Falls, Logan to Helena to Garrison, and Butte to Helena to Great Falls. A Chicago, Milwaukee, St. Paul, and Pacific line and a Union Pacific line also cross the study area; the latter also is followed by I-90 from Logan to Missoula. East-west passenger service is offered by the Amtrak line, which follows the Burlington-Northern corridor and therefore I-90 and I-94.

Paralleling railroads with transmission lines should be considered a potential high impact as the future use of trains for passenger traffic is predicted to increase.

Airports

Airlines provide service to 14 of the larger towns. In 1968, approximately 69 percent of the boardings occurred in Billings and Great Falls; if Missoula and Butte are added, the proportion rises to 86 percent, or over 380,000 people. Other towns in the study area maintaining airports serviced by airlines include Bozeman, Helena and Lewistown. Smaller airports occur throughout the study area since ownership of private airplanes is very high. The lines would comply with Federal aviation standards concerning air fields.

The Federal Aviation Agency requires that certain structures, depending on terrain, location and height, be provided with aircraft warning lights. After the line routing and tower locations are selected, a review will be made to determine which, if any, of the structures would need to be equipped with warning lights.



EXISTING RIGHTS-OF-WAY

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-20

Transmission Lines

In the eastern portion of the study area, transmission lines tend to follow major corridors such as the Yellowstone River, but the siting of transmission structures is subject to fewer topographic restrictions than that of roads (see Figure III-20). Unlike transportation corridors, major high-voltage transmission lines need to connect only major load centers, and often cross upland benches in a straight line between generating plants and load centers, ignoring minor undulations in topography and agricultural land use patterns. In the mountainous western portion of Montana, transmission line corridors usually follow the major highways (especially I-90 and I-15) because the problems of maintenance are more severe, but in some instances the lines cross forested mountain areas to minimize distance. The only existing 500-kV line in the study area runs southwestward from Hot Springs into Idaho.

Pipelines

Natural gas fields are located in Big Horn County near Hardin, in Stillwater County, and in Golden Valley County. Pipelines carrying natural gas to population centers tend to follow the major transportation corridors discussed above (see Figure III-20).

Nearly all the oil fields in the study area are found in Musselshell, Rosebud, and Yellowstone Counties. These fields are connected by pipelines to the Cenex refinery in Laurel, the Humble and Continental refineries in Billings, and the Phillips refinery in Great Falls. Pipelines carrying refined products radiate from the refineries at Billings and Laurel.

Effects of Electrical Facilities

Power transmission lines produce electromagnetic and electrostatic fields which can cause voltages to appear on wire communication circuits, such as those operated by telephone and railroad systems. The influence of the powerline 60 Hz current and its harmonies to 3000 Hz and above may be of sufficient intensity to induce electrical noise on such voice data transmission and signal circuits. Interference with wire-type communication lines and railroad signal circuits is not expected where either the transmission line and communication line are separated by more than 1/2 mile or the parallel length is less than 1 mile. Although no adverse impacts of this type are anticipated, should a utility become concerned that a problem may be occurring because of the operation of this transmission line, it could be investigated and, as appropriate, mitigated in cooperation with the affected utility.

Clearances over freeways, highways, communication and railroad signal circuits, and other roads and facilities would equal or exceed the requirements established by the National Electric Safety Code (1977). The required clearances include allowances for wind-caused conductor motion and also for increased conductor sag from ice formation on the conductors or high conductor temperature operation.

SPECIALLY MANAGED AREAS

Wilderness/Primitive Areas

The study area includes all or part of three wilderness areas and one primitive area: Scapegoat, Mission Mountain and Gates of the Mountains Wilderness Areas, and Humbug Spires Primitive Area (see Figure III-21). The wilderness areas are managed under the National Wilderness Preservation Act of 1964 to preserve and protect their natural condition. In order for a transmission line right-of-way to be routed through a classified wilderness area, the portion of the area would need to be declassified by an Act of Congress or be authorized by the President of the United States. Normally this would only be done in case of national emergency.

Primitive areas were administratively designated, prior to the passage of the Wilderness Act, to preserve their natural conditions, and are protected by the same restraints as classified wilderness areas. The Humbug Spires Primitive Area is being studied by the Bureau of Land Management to determine its suitability for wilderness. The criteria to

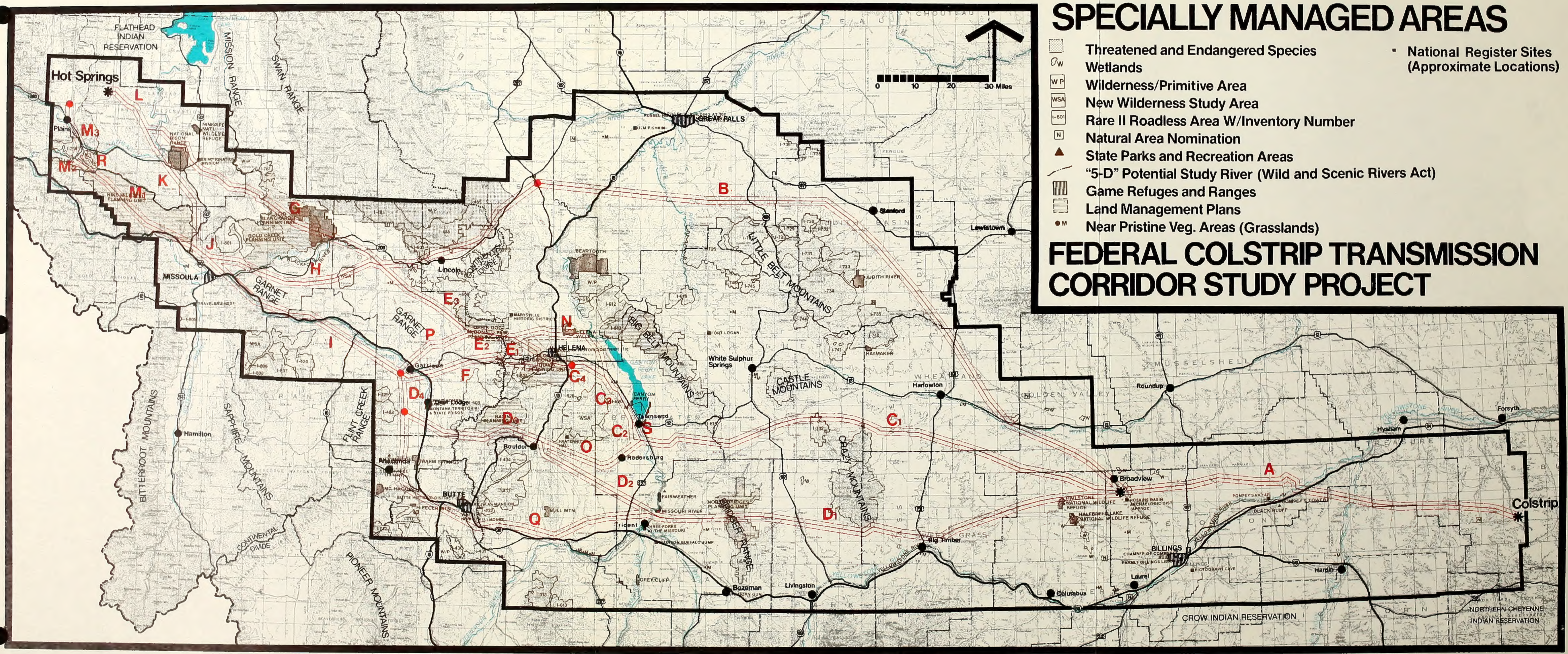


Figure III-21

be met and the period of time involved to allow nonconforming uses are similar to those for declassifying a portion of a wilderness.

New Wilderness Study Areas

This designation includes those areas selected for further study to determine if they should be recommended to Congress for addition to the National Wilderness Preservation System. Two such areas are located on National Forest land in the study area: Welcome Creek on the Lolo National Forest and Elkhorn on the Helena National Forest (see Figure III-21). The Bureau of Land Management also has an area that is designated as a wilderness study area. It is the Wales-Yourname Creek area, located in the Blackfoot River drainage. These areas are managed to protect their wilderness characteristics until detailed studies can be completed and a land use recommendation reached.

Roadless Areas

All other uncommitted roadless and undeveloped National Forest lands are included in the second Roadless Area Review and Evaluation (RARE II) inventory. These lands will be reviewed to determine their suitability for inclusion in the National Wilderness Preservation System or for other possible uses. At the present time, national criteria are being established to evaluate the inventoried areas for wilderness and other uses. Using these evaluation criteria, the inventoried RARE II lands will be placed into three separate categories:

(1) Those to be recommended for immediate addition to the National Wilderness Preservation System;

(2) Those which will undergo further study to determine whether or not they should be included in the wilderness system; or

(3) Those which should be managed for resource values other than wilderness.

These recommendations will then be sent to the Secretary of Agriculture for further review and administrative or legislative action.

The study area includes all or part of 60 RARE II inventoried lands (see Figure III-21).

Natural Areas

The Montana Natural Areas Act of 1974 provides that a system of natural areas possessing scenic, biological and geological features of educational and scientific value be established and protected. The study area includes seven areas (Figure III-21) that have been nominated for inclusion and protection under the regulations of this Act (Shea 1977):

(1) Crown Butte, 656.55 acres, approximately 31 miles west of Great Falls;

(2) Brown's Canyon, 640 acres, approximately 31 miles northwest of Harlowton;

(3) North Crazy Mountains, 640 acres, approximately 23 miles southwest of Harlowton;

(4) Swimming Woman, 640 acres, approximately 23 miles east of Harlowton;

(5) Canyon Creek, 640 acres, approximately 21 miles east of Billings;

(6) Erb Island, 60 acres, approximately 2 miles south of Laurel; and

(7) Armells Creek, 633.32 acres, approximately 10 miles west of Colstrip.

Near-pristine or relict vegetation communities within Montana's rangeland have been identified and inventoried by the USDA, Soil Conservation Service (Ross, et al. 1973). Thirty-five of these sites are located in the study area. Detailed studies of soil, climate, and vegetation have been conducted on these climax or near-pristine sites to establish ecological benchmarks upon which range conditions are based. They provide a standard for comparing presently existing vegetation against nature's potential. Each site is small, and protection is afforded through cooperation of the landowner.

Game Refuges and Ranges

The study area contains three National Wildlife Refuges as well as the National Bison Range (Figure III-21), as presented below:

National Wildlife Refuge	Acres
Hailstone	2,240
Halfbreed Lake	3,096
Ninepipe	2,022
Bison Range	18,540

Wildlife refuge areas consist of unusually productive or critical wildlife habitat (primarily waterfowl breeding and wintering areas) and are protected from land use activities that may be detrimental to their wildlife populations. The National Bison Range, located within the Flathead Indian Reservation, supports a herd of approximately 325 bison as well as herds of elk, bighorn sheep, mountain goats, mule deer, white-tailed deer, and antelope. It is managed to maintain herds of native animals in an undeveloped environment for the enjoyment of the public (Kaschke 1974).

Game management areas found within the study area are listed in Table III-9. These lands include Federal, state, and private ownerships but they are controlled by the Montana State Fish and Game Commission under lease arrangements. They are managed for the protection of certain critical game habitats. The policy is to protect these areas from

Table III-9 - WILDLIFE MANAGEMENT AREAS

Name	County	Size*	Managed For:
Black Bluff	Yellowstone	52	Waterfowl, Sharptail, Grouse
Pompeys Pillar	Yellowstone	94	Waterfowl, Pheasant
Haymaker	Wheatland	1,509	Elk, Mule Deer, Sharptail Grouse
Judith River	Judith Basin	4,873	Elk, Mule Deer, Sharptail and Mountain Grouse
Fairweather	Gallatin	4,500	Mule Deer, Pheasant, Waterfowl
Greycliff	Gallatin	605	Pheasant, Waterfowl
Missouri River	Gallatin	523	Pheasant, Waterfowl
Canyon Ferry	Broadwater	5,000	Waterfowl
Beartooth	Lewis & Clark	32,318	Elk, Mule Deer, Sharptail and Mountain Grouse
Helena Valley	Lewis & Clark	800	Waterfowl
Bull Mountain	Jefferson	3,552	Elk, Mule Deer, Mountain Grouse (blue)
Fleecer Mountain	Silver Bow	2,400	Elk, Mule Deer, Mountian Grouse
Mount Haggin	Deerlodge	25,000	Elk, Mule Deer, Mountain Grouse
Warm Springs	Deerlodge	4,445	Waterfowl, Pheasant
Blackfoot-Clearwater	Missoula	49,411	Elk, Mule Deer, Sharptail Grouse
Moiese	Lake	80	Pheasant, Waterfowl
Nine Pipe	Lake	2,755	Waterfowl, Pheasant

*Size, in acres, of that portion of management area within study area.

Source: MDFG 1977
DNRC/DEIS 1974

developments which would have adverse effects upon wildlife. In order for a transmission line right-of-way to cross land in Montana Fish and Game Department ownership, the Commission would have to grant permission for an easement. The Nature Conservancy has purchased lands for wildlife which are held in trust by the Montana Fish and Game Department. Lands deeded from the Nature Conservancy, a private conservation group, would have to be condemned, and other lands would require easements from individual landowners or administrative agencies (Brown 1974).

State Parks and Recreation Areas

The Montana Department of Fish and Game manages 9 state parks, 13 state monuments, 55 recreation areas and 138 fishing access sites. The Colstrip study area includes 3 of the state parks, 8 of the state monuments, and 3 state recreation areas (Figure III-17). According to the state's administrative code, these parks and recreation areas are managed "to provide a high quality recreation experience, distinctive and notable enough to attract people on a state, regional and national basis . . . . They are developed and managed for the protection of the natural environment and aesthetic qualities . . . . They are often located in areas which have serious deficiencies in public outdoor recreation facilities . . . ." (MDFG 1975).

Wild and Scenic Rivers

No designated wild and scenic rivers would be potentially impacted by the Applicant's proposed corridor or any of the alternatives. However, Montana State's Colstrip EIS (DNRC/DEIS 1974) notes that sections of the Yellowstone, Madison, and Blackfoot Rivers have been selected by the Secretary of the Interior as "5-D" Potential Study Rivers. Such a designation requires that these sections of the rivers would require study under the provisions of the Wild and Scenic Rivers Act should a Federal project be proposed.

Scenic Travelways

Both Montana residents and out-of-state visitors spend the greatest share of their recreating time either driving or walking for pleasure (MDFG 1973). This is supported in the Montana Driver's Manual, which states that "The marvelous beauty of Montana can best be appreciated by motor vehicle travel through Big Sky Country."

The Montana Administrative Code recognizes that "Although no specific units within scenic highway and trail categories have yet been designated, the addition of such units to the State Park System is projected. The Department of Fish and Game believes that the scenic and cultural attributes of certain Montana roads and trails are of high recreational value and warrant formal protection against uncontrolled use and development. The preparation of criteria for State recreational roads and trails is in progress along with other plans for this potentially valuable expansion of the State Park System" (MDFG 1975).

The National Recreation Advisory Council has designated the U.S. Bureau of Public Roads to conduct a study of highways, roads and streets within Montana for possible inclusion in a national program of scenic roads. This study is currently being carried out and promises to place 1900 miles of Montana roads within the national program (WESD/AEA 1973).

Ongoing National Historic trail programs in Montana that intersect the Colstrip study area are:

1. The Lewis and Clark Trail

2. The Old West Trail

3. Rocky Mountain Trail System (along the Continental Divide)

In addition, the Nez Perce Indian Trail is in the process of being added to the National Historic Trails Program (see Figure III-17).

As a result of both state and Federal recognition of Montana's highways and trails and the popularity of driving and walking for pleasure, the Study Team regarded all major highways, roads, and trails as having scenic value.

Recreational Waterways

A number of the better Montana streams and rivers have been declared as members of the State Recreational Waterway System. The streams that make up the system are: the Flathead River and its three forks above Flathead Lake; the Missouri River from Fort Benton to the head of Fort Peck Reservoir; the Yellowstone River from Yellowstone Park to Billings; Rock Creek near Missoula; and the Smith River which joins the Missouri near Ulm, Montana (MSPB, no date; also see Figure III-7). The State of Montana established this system under Montana Administrative Code 12-2.26.26(1-S2670S) to protect and enhance the natural and historical values of these waterways and to provide opportunities for their enjoyment (Montana Administrative Code 12-75).

The Montana State Fish and Game Department administers this system of recreational waterways and a complementary system of fishing access sites (MDFG 1975). The three major goals of the recreational waterways are: (1) to maintain streams as free-flowing, productive waters and improve their quality and recreational potential wherever possible; (2) to improve streams of secondary quality so that they will eventually be appropriate for placement in the system; and (3) to develop the recreational waterways in a manner that will encourage and attain maximum recreational use by local residents and out-of-state visitors. The system administrators believe that high quality fishing is an outstanding feature of Montana's streams and that multiple recreational use necessarily involves all of the uses that are compatible with and non-detrimental to stream fishing" (WESD/AEA 1973).

The Montana Fish and Game Department, in 1959, joined with the U.S. Bureau of Sport Fisheries and Montana State University to create a stream classification committee which establishes stream classification criteria. This committee designated as "blue ribbon" those waterways having both national and state-wide, high quality fishing values. Blue ribbon streams within the study area are: the Big Hole River, the Flathead River, the Madison River, the Missouri River, Rock Creek (east of Missoula), the West Gallatin River, and the Yellowstone River (CMFS no date).

The Montana Fish and Game Department presently maintains approximately 100 fishing access sites in conjunction with its recreational waterways system. About two of these fishing access sites are within the Colstrip study area.

A 30-mile stretch of the Blackfoot River between Bonner, Montana, and Ovando, Montana, has been set aside as a special conservation and recreation management area "to protect natural, scenic, and the recreation integrity of the Blackfoot Corridor through effective management of public recreation and restrictions on ecologically incompatible uses and development." Beginning in 1960, individual landowners along the river in Missoula and Powell Counties began efforts to develop a recreation and scenic protection plan for their respective lands. This effort culminated in a joint, Federal, State, and locally sponsored recreation management plan in 1976.

The Montana legislature, in 1975, passed HB No. 341 directly in support of the Blackfoot River Management Program. This bill amended the existing Open Space and Land Act to provide for conservation and (scenic) easement "restrictions that may prohibit or limit utilities or other structures on or above the ground."

The Blackfoot River Corridor finally established for protection was recommended by a field team from the Heritage, Conservation, and Recreation Service (formerly Bureau of Outdoor Recreation), the Nature Conservancy, and involved local parties (NC and BOR 1976).

Management Objectives for Specified Areas

Within the study area, eight of the National Forest planning units that would be impacted by the transmission line corridor segments have published environmental statements. Each statement includes the management plan and management guidance for the planning unit. Five of these are final statements and three are draft statements. A final statement indicates that planning has been completed under the NEPA process. A draft statement presents a proposed plan for public review and comment and has not yet completed the planning process. The remaining planning units that would be impacted by transmission lines are in various stages of plan preparation, as listed below and shown in Figure III-21:

National Forest	Planning Unit	Environmental Statement
Gallatin	North Bridger	Final - 1973
Deerlodge	Basin	Final - 1976
Helena	Magpie-Confederate	Draft - 1976
Helena	Colorado-Unionville-Travis	Draft - 1976
Helena	Ophir-Dog-MacDonald Pass	Final - 1977
Lolo	Placid-Blanchard	Draft - 1977
Lolo	Gold Creek	Final - 1974
Lolo	Ninemile-Mill	Final - 1977

Management objectives and management guidance have been developed for each of these planning units. The following summary of each management plan focuses on concerns with high voltage transmission lines and the areas crossed by the alternate corridor segments depicted in Figure IV-1.

North Bridger Planning Unit (USDA Forest Service 1973b)

The existing roadless area is to be maintained. If additional transmission lines are needed over Flathead Pass, they will utilize the existing powerline right-of-way.

Basin Planning Unit (USDA Forest Service 1976b)

Management Area 3 - The direction is to manage the vegetative cover to maintain or enhance wildlife and to protect the aesthetic qualities of the area. Emphasis will be on maintaining winter range for deer and elk. There are no specific management guidance items relative to transmission lines.

Magpie - Confederate Planning Unit (USDA Forest Service 1976c)

Management Unit III - The management direction for this unit is to optimize production of timber from the more productive growing sites, optimize grazing on primary livestock range and protect key wildlife habitat. No action will be taken or allowed in the Boulder Mountain Roadless Area (RARE II No. 1-616). There are no specific management guidance items relative to transmission lines other than avoiding the roadless area.

Management Unit IV - The mangement direction for the unit is to manage key wildlife habitat and scenic values. There are no specific management guidance items relative to transmission lines. However, the final environmental statement will reflect more concern for the protection of scenic values. The portion of the Big Belt Mountains that is highly visible from Canyon Ferry Lake receives high recreation use.

Management Unit V - The management direction for this unit is to manage it as an undeveloped dispersed recreation area and as a security area for big game. The management guidance items are specifically directed towards roadless management, and the management unit would be closed to use by motorized vehicles.

Colorado - Unionville - Travis Planning Unit (USDA Forest Service 1976d)

Management Unit A - The primary management goals for this unit are to manage it as wildlife habitat, watershed, and as a scenic backdrop for Helena, Unionville, and Colorado Gulch. Dispersed recreation activities that do not affect water quality or detract from natural beauty or wildlife habitat will be emphasized. New special use permits may be allowed only when no alternative is feasible, and only intermittent service and short-term roads will be permitted.

Management Unit B - Management activities will place emphasis on enhancing dispersed recreation opportunities near the city of Helena. Due to the high volume of day use dispersed recreation in this area, a more intensive level of recreation management will be applied to protect the scenic values and other resources. No additional miscellaneous special uses would be allowed except in cases of overriding necessity. New transmission lines and replacements are to be placed underground whenever feasible.

Management Unit C - This unit is to be managed primarily for watershed and as a scenic backdrop for Helena, Unionville, and Colorado Gulch. Dispersed recreation activities that do not affect water quality or detract from natural beauty will be emphasized. Special use permits would be granted only where: no alternative is feasible, the use is essential to the applicant, and there is no significant impact on the land and resources. Only intermittent service and short-term roads for limited access would be allowed.

Management Unit D - Management activities will place emphasis on dispersed recreation and wildlife habitat management. Timber and range resources will be developed and managed as compatible with recreation, wildlife and scenic values. Special use permits would be allowed only where: no other alternative is feasible, the use is essential, and there is no significant impact on other resources.

Ophir - Dog - MacDonald Pass Planning Unit (USDA Forest Service 1977a)

Dog Creek Management Unit - Management emphasis will be placed on intensive management of timber and range production. Recreation development, watershed, and wildlife habitat management will be secondary goals. Special use facilities will be designed for minimum disturbance and easy rehabilitation upon closure of the permit. Utility corridors that are compatible with management direction and designed to minimize the impact on scenic values will be allowed.

Clark Canyon Management Unit - Wildlife habitat management is of primary concern in this management unit. Timber, grazing, watershed, and recreation will be managed to maintain or improve wildlife habitat. Utility corridors that are compatible with management direction and designed to minimize impact on wildlife security cover and scenic value will be allowed.

Placid - Blanchard Planning Unit (USDA Forest Service 1977b)

Management Unit 2 - The management objectives are to maintain or improve the deer and elk habitat consistent with populations using the area, and to maintain vigorous stands of timber and optimize timber growing potential.

Management Unit 3 - The management objectives for this management unit are to maintain or improve the deer and elk habitat, and to maintain vigorous stands of timber and optimize the timber growing potential within the constraints imposed by the highly erodible soils.

An existing 230-kV transmission line traverses portions of these units and it is recognized that it is feasible to locate additional lines through this area. Protection of visual quality values, especially in the Lost Prairie and Placid Lake areas, will be a key consideration in any future route evaluation. However, the Forest Service will defer taking action on any request for a route right-of-way until the route to the west, across the Flathead Indian Reservation, is resolved. The Tribal Council of the Confederated Kootenai and Salish Tribes will make a determination on whether or not to allow the transmission corridor through the reservation.

Gold Creek Planning Unit (USDA Forest Service 1974b)

Management Unit 2 - The National Forest land within this management unit will be managed for dispersed recreation, watershed, and wildlife with the timber resource being harvested as a secondary management objective. Special uses such as powerlines which will detract from the view generally will not be allowed. However, requests will be evaluated and considered if future needs demand that a powerline corridor be developed and no other suitable alternative route can be found.

Management Unit 5 - The National Forest land within this management unit will be managed for recreation, esthetics, watershed, and fisheries with the protection of the stream paramount. Timber management will be a secondary objective. No special uses which disrupt the viewing of the canyon will be allowed.

Management Unit 6 - Management emphasis in this unit will be to maintain a vigorous stand of timber and optimize the timber growing potential while giving full consideration to the soils, watershed, and wildlife values. There are no specific management guidance items relative to transmission lines for this management unit.

Ninemile - Mill Planning Unit (USDA Forest Service 1977c)

Management Unit C - The primary management objective is to maintain the esthetic quality as viewed from Interstate 90 and adjacent subdivisions. Secondary objectives include protection and maintenance of existing levels of productive winter habitat for deer and elk, protection of the dispersed recreation opportunities, maintenance of healthy timber stands consistent with the visual and wildlife objectives, and providing forage for domestic livestock consistent with the wildlife objective. The visual quality objective is Retention, which provides only for management activities which are not visually evident (see "Visual Resources," Chapter V). Activities may only repeat form, line, color, and texture which are frequently found in the characteristic landscape. Changes from these qualities should not be evident.

Management Unit D - The primary management objective is to maintain existing levels of productive winter habitat for deer and elk. Secondary objectives are to maintain the visual quality, protect and enhance the dispersed recreation opportunities, maintain healthy timber stands consistent with the preceeding objectives, and to provide forage for domestic livestock consistent with the wildlife objective. The visual quality objective is Partial Retention, which means that management activities are to remain visually subordinate to the characteristic landscape (see "Visual Resources," Chapter V).

Management Unit E - The primary management objective is to maintain and/or improve the visual quality. Secondary objectives are to protect and enhance the dispersed recreation opportunities, maintain healthy timber stands consistent with the visual quality objective, provide forage for domestic livestock consistent with water quality and dispersed recreation objectives, and to protect historic values. The visual quality objective is Partial Retention, except along the foreground of trails where it is Retention (see Management Units C and D for an explanation of these terms). Where unacceptable landscape modification exists, rehabilitation of these areas will be carried out.

Management Unit F - The primary management objective is to maintain healthy timber stands and optimize the timber growing potential. Secondary objectives are to maintain and/or improve the visual quality, provide a variety of recreation activities, and to provide forage for domestic livestock consistent with the water quality objective. The visual quality objective is Modification, where management activities may visually dominate the original characteristic landscape. However, structures and roads must still remain visually subordinate to the proposed landscape composition.

Management Unit G - The primary management objective is to maintain existing levels of productive winter habitat for deer and elk. Secondary objectives are to protect and enhance the dispersed recreation opportunities, maintain the visual quality, maintain healthy timber stands consistent with wildlife and visual quality objectives, and to provide forage for domestic livestcok consistent with wildlife and recreation objectives. The visual quality objective is Modification (see Management Unit F).

Management Unit H - The primary management objective is to maintain healthy timber stands and optimize the timber growing potential. Secondary objectives are to provide a variety of recreation opportunities and to provide forage for domestic livestick consistent with water quality objectives. The visual quality objective is Maximum Modification, which allows for vegetative and landform alterations to dominate the characteristic landscape. Structures and roads must remain visually subordinate to the proposed composition as viewed in the background.

Management guidance for the entire planning unit provides that electrical power transmission lines will not be approved unless an environmental impact statement is prepared which indicates there is a need and the route through the planning unit has the least impact. Any use must be designed and installed in a way which will meet the management objectives for the management unit where the use will occur.

SOCIAL AND ECONOMIC CONSIDERATIONS

Montana's economy has historically been based on its natural resources: agriculture, mining, and wood products. These natural resources will continue to be the major basis of the state's economy, but the service and trade-related sectors will provide an increasing number of employment opportunities (Montana Department of Community Affairs 1975). This trend is consistent with the national pattern. The tourism and travel sector is another major Montana industry which has grown substantially over the last few years. With a nationally rising per capita income and increasing leisure time, this sector should continue to expand since Montana is noted for her natural beauty and colorful past.

The economy of the state as a whole is growing very slowly. It "cannot supply enough jobs for its residents" and "provides its people with an average income per person well below the United States average. In 1970, Montana's per capita income was 14 percent below the national figure; in 1950, it had been 8 percent above the national average" (Johnson 1972:14). There is no single explanation for this low per capita income, "but [it] may be partly due to the rural nature of the State" (Montana Department of Community Affairs 1976:13).

The performance of the state's regional economies has varied. "For the most part, and with some notable exceptions, the larger urban areas have grown and prospered and the rural areas and small towns have suffered the losses. On a geographic basis, western Montana has posted the best record in the state in terms of economic growth" (Johnson 1972:18).

In this social and economic analysis, the study area is divided into an eastern portion and a western portion for discussion purposes (see Figure III-22), each having a different economic base and a different economic performance. The east portion is comprised of the following 12 counties: Rosebud, Treasure, Big Horn, Yellowstone, Musselshell, Golden Valley, Stillwater, Sweet Grass, Wheatland, Judith Basin, Meagher, and Broadwater. The thirteen western counties are: Park, Gallatin, Madison, Jefferson, Cascade, Lewis and Clark, Powell, Silver Bow, Deer Lodge, Granite, Missoula, Lake, and Sanders.

DEMOGRAPHICS AND HOUSING

In the 1960s, the population of the western part of the study area expanded more rapidly than that of the eastern part. Only 2 of the 12 eastern counties experienced a growth in population, while 7 of the 13 western counties experienced growth in population during this period. From 1970 to 1976, however, the counties in the eastern part of the study area grew at a faster rate than those in the western part (see Table III-10).

The housing vacancy rate of the 1970 census in the eastern portion ranged from 4.8 percent in Yellowstone County to 30 percent in Meagher County. The vacancy rate in the western portion ranged from 3.9 percent in Missoula County to 24.3 percent in Granite County. Both portions of the study area have nearly the same average 1970 census housing vacancy rate, 8.4 percent (east) and 8.9 percent (west). The counties with a 1970 housing vacancy rate of 5 percent or less (Yellowstone, Gallatin, and Missoula) are the more urbanized counties in the study area and, logically, had the highest population growth in the 1960's. There is no significant difference between the east and west parts of the study area

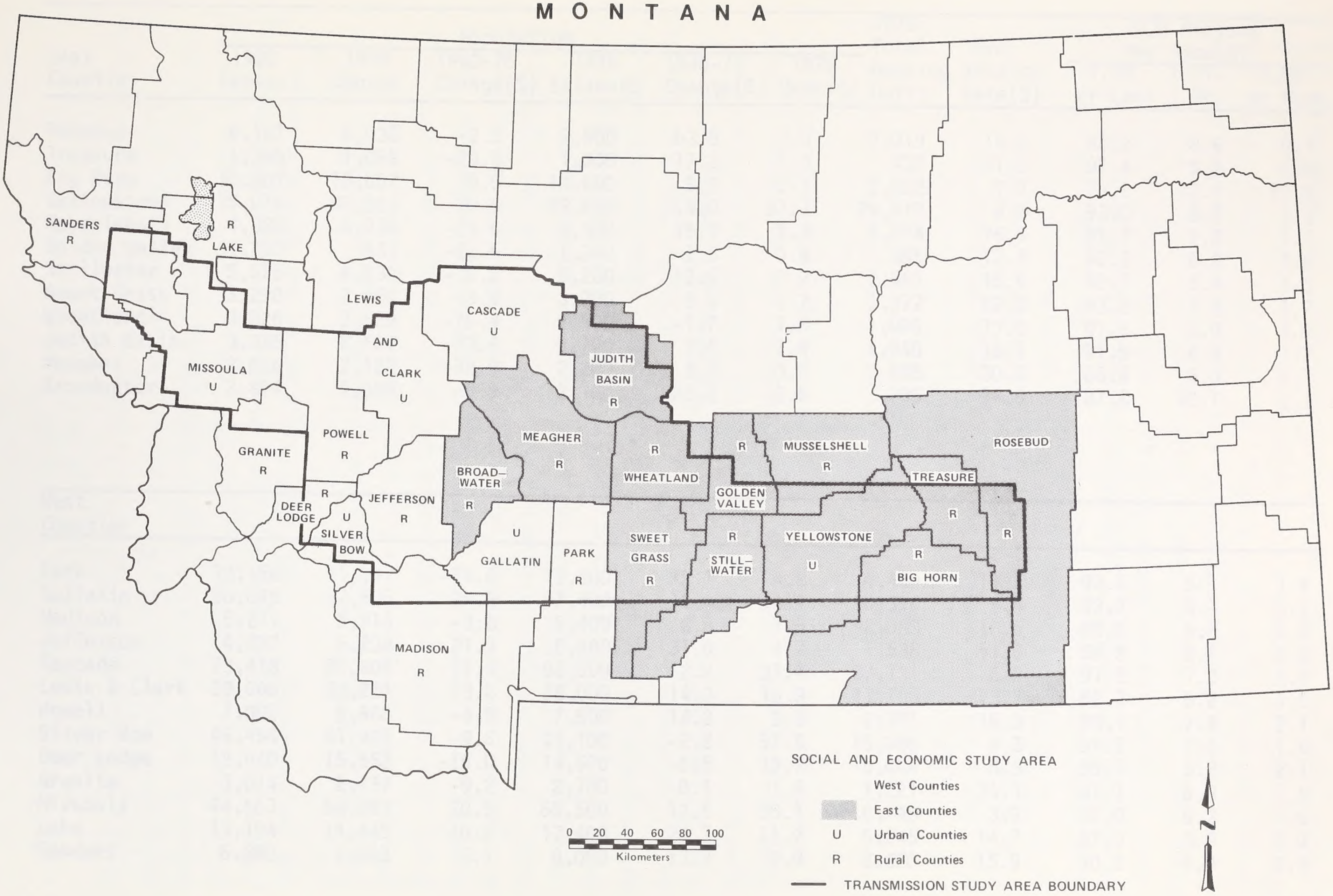


Figure III-22

Table III-10 - DEMOGRAPHIC AND HOUSING DATA

East Counties	Population 1960 Census	1970 Census	1960-70 Change(%)	1976 Estimate	1970-76 Change(%)	1976 Density	1970 Total Housing Units	1970 Vacancy Rate(%)	1970 Persons Per Room(%) 1.00 or Less	1.01-1.50	1.51 or More
Rosebud	6,187	6,032	-2.5	9,900	63.9	2.0	2,019	10.0	82.2	8.6	9.1
Treasure	1,345	1,069	-20.5	1,300	17.2	1.3	432	21.3	92.4	5.9	1.8
Big Horn	10,007	10,057	0.5	10,600	5.3	2.1	2,868	7.1	76.9	12.1	11.0
Yellowstone	79,016	87,367	10.6	99,600	14.0	37.7	29,019	4.8	93.0	5.7	1.3
Musselshell	4,888	3,734	-23.6	4,400	18.3	2.3	1,574	16.1	91.7	7.2	1.1
Golden Valley	1,203	931	-22.6	1,000	2.5	0.9	365	12.1	92.2	6.2	1.6
Stillwater	5,526	4,632	-16.2	5,200	12.6	2.9	1,881	15.6	92.7	5.9	1.5
Sweet Grass	3,290	2,980	-9.4	3,200	5.9	1.7	1,372	23.0	93.8	4.6	1.7
Wheatland	3,026	2,529	-16.4	2,500	-1.7	1.8	1,006	13.0	01.5	5.0	3.4
Judith Basin	3,085	2,667	-13.5	2,700	1.4	1.4	1,040	16.1	91.9	6.4	1.7
Meagher	2,616	2,122	-18.9	2,200	3.3	0.9	988	30.3	88.4	6.0	5.7
Broadwater	2,804	2,526	-9.9	3,100	23.3	2.6	795	14.6	87.8	10.1	2.1
West Counties											
Park	13,168	11,197	-15.0	12,600	12.1	4.8	4,460	11.5	93.6	5.1	1.4
Gallatin	26,045	32,505	24.8	37,400	15.1	14.9	10,314	5.4	93.7	5.1	1.2
Madison	5,211	5,014	-3.8	5,400	8.7	1.5	2,083	18.6	92.5	5.0	2.5
Jefferson	4,297	5,238	21.9	6,900	31.0	4.2	1,538	11.6	88.8	8.4	2.8
Cascade	73,418	81,804	11.4	83,600	2.2	31.4	27,131	6.9	91.2	7.2	1.7
Lewis & Clark	28,006	33,281	18.8	38,000	14.3	10.9	11,763	13.7	92.2	6.2	1.6
Powell	7,002	6,660	-4.9	7,600	14.2	3.3	2,395	15.3	90.1	7.7	2.1
Silver Bow	46,454	41,981	-9.6	41,100	-2.2	57.5	15,586	9.3	91.2	7.0	1.8
Deer Lodge	18,640	15,652	-16.0	14,600	-6.5	19.7	5,004	8.5	89.1	8.8	2.1
Granite	3,014	2,737	-9.2	2,700	-0.1	1.6	1,221	24.3	91.1	6.9	1.8
Missoula	44,663	58,263	30.5	65,500	12.5	25.1	18,748	3.9	92.0	6.3	1.6
Lake	13,104	14,445	10.2	17,400	20.7	11.7	5,245	14.7	87.3	8.9	4.0
Sanders	6,880	7,093	3.1	8,000	13.3	2.9	2,820	15.9	90.2	6.9	2.9

in the number of persons per dwelling unit room. Two counties in the eastern part, Rosebud and Big Horn, do have a large number of relatively crowded dwelling units (9.1 percent and 11 percent respectively with 1.51 or more persons per room). In both the east and west parts of the study area, the counties with an urban population tend to have higher valued housing stock. Cascade, Gallatin, Lewis and Clark, Missoula, and Yellowstone counties had a 1970 median value in the range of $15,000 to 19,999, the highest in the study area. Silver Bow County, the remaining county designated as "urban", had a 1970 housing stock with a median value in the $10,000-$14,999 range; this range was also common to Lake, Park, Powell, and Sweet Grass Counties (Montana Department of Community Affairs 1975).

EMPLOYMENT BY INDUSTRY

A primary distinction between the eastern and the western parts of the study area is the importance of agriculture and the wood products industries to the local economies. As shown in Table III-11, the percentage of the work force in each county employed in agriculture is much higher for most of the east counties than for the west counties, whereas the percentage of the work force employed in the wood products industry tends to be higher in the west counties than in the east counties. The percentage of the work force employed in the government sector is also higher in the western counties than in the eastern counties (25 percent as compared to 13 percent in 1972; Montana Department of Community Affairs 1975). This high percentage of government employment is a stabilizing influence in those counties, in that government jobs are more secure. Many of those counties which continued to attract population during the 1960s have a high percentage of employment in government.

The percentage of the labor force employed in the services sector is higher for urbanized counties than for the more rural counties (see Table III-11). Yellowstone, Silver Bow, and Missoula Counties have in excess of 20 percent of all jobs in that sector, and Gallatin and Cascade have in excess of 17 percent. The trade sector accounts for only 13 percent of total employment in Lewis and Clark County, but the relative

Table III-11 - EMPLOYMENT STATISTICS, 1970

East Counties	Employment Labor Force	Unemployment(%)	Participation Rate (%)		Employment by Sectors(%)[1]							
			Men	Women	Farm[2]	Gvt	Mfg	Wood Prod[4]	Mining	Trade	Service	Other[3]
Rosebud	2,346	4.6	76.3	43.0	26.9	17.2	0.0	0.0	0.0	8.3	15.2	10.1
Treasure	385	1.3	80.8	35.0	52.2	16.1	0.0	0.0	0.0	7.9	0.0	8.3
Big Horn	3,317	4.6	75.4	31.4	28.6	19.4	8.8	0.0	1.8	11.6	14.2	6.0
Yellowstone	35,170	5.8	78.4	42.3	4.7	16.9	9.2	0.2	1.1	25.6	17.0	16.0
Musselshell	1,440	7.4	70.2	37.2	22.2	15.0	2.1	0.0	11.9	13.7	11.5	4.2
Golden Valley	387	4.7	77.7	45.8	54.0	19.1	0.0	0.0	0.0	6.2	0.0	5.5
Stillwater	1,617	5.4	72.4	26.9	37.9	15.1	3.6	2.5	0.0	10.1	8.9	7.8
Sweet Grass	1,276	2.1	75.0	40.0	35.2	16.6	1.0	0.1	0.0	15.4	6.7	7.5
Wheatland	1,096	1.5	83.3	38.1	26.9	17.1	1.4	0.1	0.0	12.2	9.9	14.8
Judith Basin	1,018	2.8	79.7	28.4	51.6	18.4	0.0	0.0	0.0	7.4	2.6	2.1
Meagher	1,065	8.1	77.9	33.1	34.6	18.7	6.6	6.5	0.0	15.9	4.9	6.0
Broadwater	1,003	3.4	71.4	35.8	39.6	14.7	6.5	5.4	0.0	11.6	7.8	2.4
West Counties												
Park	4,488	5.6	72.2	40.1	15.5	11.8	6.2	2.2	0.0	15.4	15.0	22.0
Gallatin	12,877	5.4	66.7	40.4	10.1	29.8	7.7	0.8	0.0	17.1	14.5	3.9
Madison	2,017	5.7	72.5	40.0	34.8	21.9	0.0	0.0	0.0	8.4	9.6	3.5
Jefferson	1,768	4.5	62.2	37.3	13.9	51.6	0.8	0.6	1.2	5.8	9.4	5.3
Cascade	29,990	6.2	84.6	36.1	4.0	31.2	8.2	0.1	0.1	19.5	15.0	14.9
Lewis & Clark	14,751	4.9	79.0	51.5	4.2	32.6	6.0	0.6	0.0	13.8	17.7	17.3
Powell	2,446	4.7	66.4	38.7	15.8	33.2	8.5	7.2	0.0	10.1	6.9	9.6
Silver Bow	15,504	6.1	73.2	36.8	1.0	14.1	4.4	0.3	21.6	21.0	17.4	11.4
Deer Lodge	5,692	7.0	66.5	34.9	2.4	29.4	0.0	0.0	0.0	10.1	11.3	8.5
Granite	999	5.1	71.3	26.7	24.8	24.2	11.7	11.5	3.2	11.8	3.1	4.0
Missoula	23,168	7.6	72.0	42.2	2.2	21.3	15.0	11.7	0.0	20.9	15.8	15.1
Lake	4,821	6.5	64.5	34.3	29.7	19.5	7.4	6.5	0.0	11.9	11.3	4.8
Sanders	2,480	11.9	70.0	32.1	16.3	21.5	16.4	16.2	0.6	8.6	12.7	12.1

1 - Does not include non-farm proprietors
2 - Includes farm proprietors
3 - Includes: construction, transportation, communication, public utilities, finance, insurance, real estate, and others
4 - Subset of manufacturing

importance of this sector is dampened by the high percentage of government jobs located in the State Capitol at Helena.

The average 1970 unemployment rate in the east part of the study area was significantly lower (5.3 percent) than the average rate of 8.5 percent in the western counties. Although this may seem inconsistent with the superior performance of the economies of the west part counties in the 1960s, it ignores the fact that many of those unable to secure employment in the east Montana counties moved elsewhere. Some of those who left the eastern counties undoubtedly moved to urban areas and to counties in western Montana, thus simultaneously reducing the average unemployment rate in the east and increasing that in the west.

The 1970 average per capita income for the study area was $3,526. In only 2 of the 13 western area counties was this figure equalled or exceeded, whereas 7 of the 12 eastern counties had 1970 per capita incomes which met or exceeded the average for the study area. "It is surprising that the residents of an area which is growing more rapidly than the state as a whole would have below average incomes . . . (A)gricultural incomes (are) part of the explanation. Western Montana farmers and ranchers in general are much less prosperous than their eastern Montana counterparts" (Johnson 1972:20) In addition, the 1970 census figures indicate that a greater percentage of the eastern population than of that in the west is in the labor force. However, in 7 of the 12 eastern counties, more than 20 percent of the families had a 1969 income that was less than 125 percent of the government-designated poverty level. By contrast, the above applied to only 2 of the 13 western counties. This indicates that the east counties have a good number of both very wealthy families and poor people, whereas the west counties have a higher percentage of middle income families.

TAXES

The 1970 per capita state and local property taxes for the urban counties of Yellowstone, Gallatin, Cascade, Lewis and Clark, and Missoula were lower than those for the remaining, more rural counties. Although

Silver Bow County has a large, relatively urban population, its per capita tax rate is about the average for the study area (see Table III-12), a figure higher than would normally be expected.

This higher than normal tax rate is due in part to the declining population this county has experienced since 1960. As a rule, per capita payments of state and local taxes in urbanized areas are lower whereas social services are more comprehensive. For example, there are established city police departments rather than a reliance on the county sheriff and State highway patrolmen, there are full-time professional fire departments rather than volunteer departments; better and closer medical personnel and hospitals serve urban areas; and welfare benefits are more accessible and comprehensive (DNRC/DEIS 1974).

SOCIAL SERVICES

Schools

School enrollments in the study area show a general declining trend. In ten of the 25 counties in the study area, enrollments at both elementary and high school levels were smaller for the 1974-75 school year than for the 1968-69 school year (see Table III-12). Big Horn, Sweet Grass, Meagher, Broadwater, Madison, Granite, and Missoula Counties all had smaller 1975-76 elementary school enrollments than in 1968-69 but larger high school enrollments. This reflects the national trend of the post-World War II baby boom passing through the school system and into the job market.

In four counties, the 1974-76 enrollments increased from those for 1968-69, for both elementary and high school levels. This trend is expected for Rosebud, Jefferson, and Lake Counties since their populations increased significantly in the 1970-76 period. However, Sanders County also experienced increases in both elementary and high school enrollments in the 1975-76 school year over the 1968-69 school year, although its population grew only modestly between 1970 and 1976.

Table III-12 - TAXES, SCHOOL ENROLLMENT, AND MEDICAL CARE

East Counties	1970 Per Capita Income	1969 Median Family Income	% of Families w/1969 Income Less Than 125% of Poverty Level	1970 Per Capita State & Local Taxes	School Enrollment 1968-69 Elem	School Enrollment 1968-69 High	School Enrollment 1974-75 Elem	School Enrollment 1974-75 High	# Hosp	1975 Phys Per 1000 Pop	Other Health Facilities[1]
Rosebud	$3,438	$6,714	25.7%	$115	1,289	472	1,675	648	1	0.1[4]	-
Treasure	4,247	6,909	28.6	100	220	95	185	114	-	-	-
Big Horn	3,074	7,275	28.6	53	2,261	614	2,309	787	1	-	-
Yellowstone	3,731	8,966	13.3	41	16,190	6,960	14,819	7,566	2	-	-
Musselshell	3,262	6,763	18.4	86	649	330	560	321	-	-	-
Golden Valley	3,791	7,333	14.5	197	140	92	133	66	-	-	-
Stillwater	3,381	6,752	21.5	94	757	420	764	422	1	-	-
Sweet Grass	3,514	6,530	22.8	103	440	222	406	214	1	-	-
Wheatland	3,618	7,467	18.5	102	484	243	392	207	1	-	-
Judith Basin	4,231	7,145	15.9	155	467	232	375	230	-	-	-
Meagher	3,877	6,915	23.1	115	372	129	363	159	1	0.5[1]	1[1]
Broadwater	3,591	7,038	27.1	106	475	211	425	215	1	1.1[1]	1[1]
West Counties											
Park	$3,221	$7,659	16.0	58	1,946	922	1,786	936	1	1:0[1]	2[1]
Gallatin	3,129	8,832	12.0	44	5,009	2,152	5,000	2,530	1	1.2[1]	4[1]
Madison	3,308	6,745	25.7	97	656	386	416	214	2	0.9[1]	1[1]
Jefferson	2,725	8,520	12.8	59	777	325	1,100	420	1	-	2[1]
Cascade	3,775	8,952	13.3	50	17,597	5,983	14,187	6,592	2	1.3[4]	-
Lewis & Clark	4,033	10,254	10.1	48	5,795	2,586	6,065	2,807	3[3]	2.6[1]	4[1]
Powell	3,250	8,442	15.3	71	1,390	558	1,192	563	1	-	-
Silver Bow	3,449	8,670	13.1	85	7,597	3,293	7,452	3,311	2	1.8[1]	2[1]
Deer Lodge	3,132	8,275	12.1	56	2,540	1,238	2,365	1,135	3	0.6[1]	1[1]
Granite	2,594	7,123	15.7	89	586	231	392	249	1	0.4[1]	0
Missoula	3,313	9,052	12.8	47	9,762	4,245	10,139	4,567	3	2.0[2]	6[2]
Lake	2,496	6,786	26.2	77	2,663	1,134	3,001	1,354	3	0.74[2]	3[2]
Sanders	2,833	7,839	17.6	85	1,301	578	1,300	615	1	0.4[2]	3[2]

1 - Southwestern Areawide Health Planning Council, 1975
2 - Northwestern Montana Health Planning Council, 1975
3 - Includes Fort Harrison, U.S. Veterans Administration Hospital
4 - 1973 Population

The 1975-76 student/staff ratios for schools in the study area do not fall into predictable east-west or urban-rural patterns. For elementary schools, the student/certified staff ratio ranges from 12.3 to 21.1 and for secondary schools, from 6.0 to 19.2. With the exception of Big Horn and Powell Counties, the student/staff ratio is higher for elementary than for secondary schools. By law, a greater variety of courses must be offered at the secondary level than at the primary level, thus requiring the higher level of staffing. There are fewer high schools than elementary schools in each county, and they tend to have larger student bodies.

Health Services

Only four counties in the study area have no hospital facilities. Two of these--Treasure and Golden Valley--also had the smallest 1976 estimated population. Judith Basin County does not have a hospital, whereas two adjacent counties with smaller populations each have a hospital. Musselshell County does not have a hospital but its residents are served by hospitals in Billings and Lewistown. The physician/patient ratio is highest in the more populated counties. Many rural areas do not have large enough populations to support a physician, so the health care needs of the residents are not as well met.

Law Enforcement

The number of cases handled by Montana's judicial system has been increasing at a faster rate than the population (Montana Legislative Council 1976). In addition, Montana's 18 judicial districts are ill-proportioned when measured by population, geographic area, or case-filings (Montana Legislative Council 1976:15). Nine counties in the Colstrip study area are in judicial districts with substantially higher than average ratios for both population per judge and casefilings per judge. These are Treasure, Big Horn, Yellowstone, Stillwater, Gallatin, Cascade, Missoula, Sanders, and Lake. "Not surprisingly, the districts that have had heavy or above-average casefilings each contain at least one substantial urban center . . . (and) had relatively high caseload-to-population ratios. That is, there were more casefilings per population in these districts than in the others" (Montana Legislative Council 1976:25). Despite the heavy workloads in some of the district courts, Montana is within the national standard proposed to guarantee a speedy trial in criminal cases (Montana Legislative Council 1976:37).

DISCUSSION OF CONFEDERATED SALISH AND KOOTENAI TRIBE

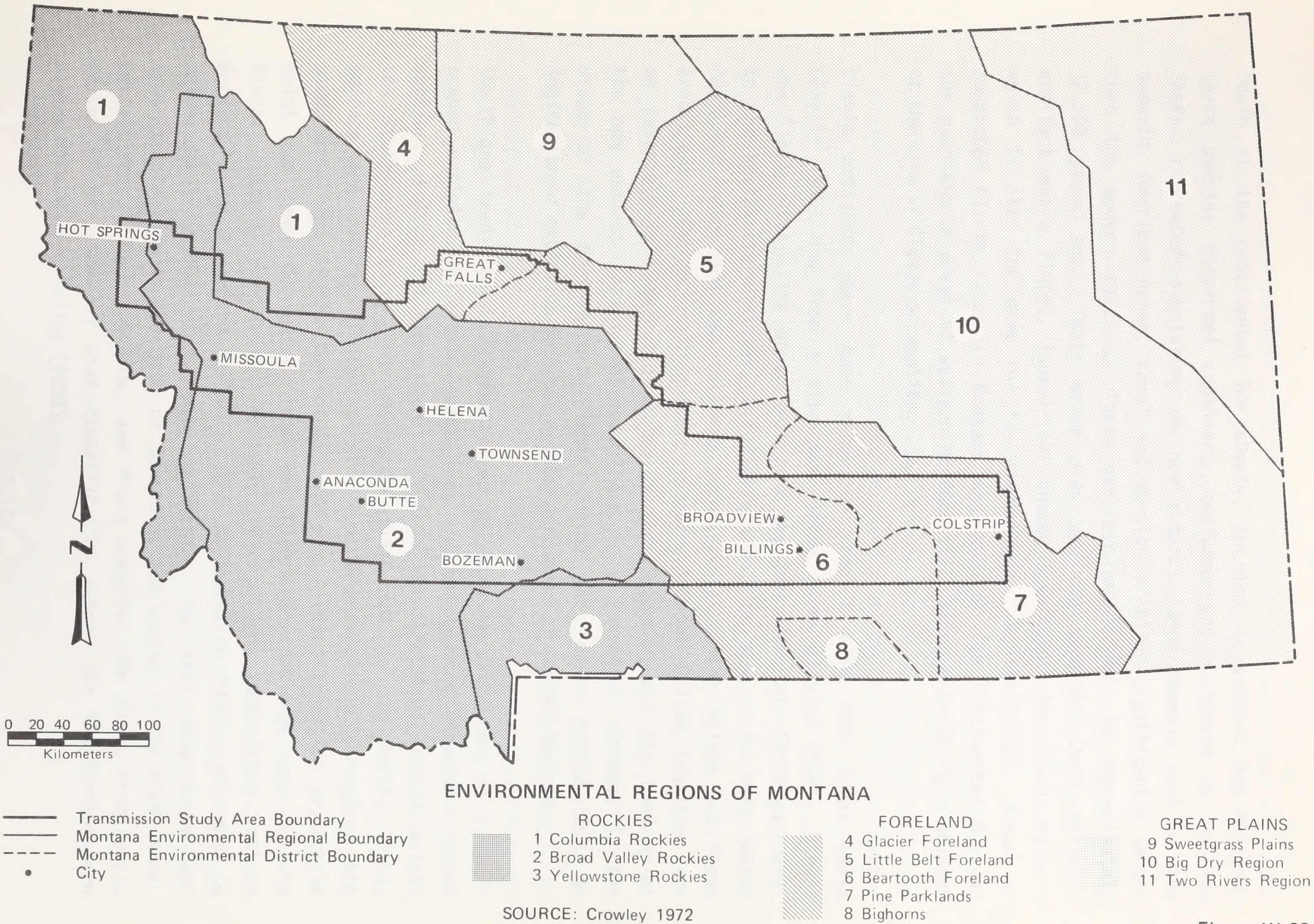
The information needed to assess the impacts of the proposed action and alternatives on the Confederated Salish and Kootenai Tribe and their reservation was requested from the Bureau of Indian Affairs and from the Tribe. The information has not been provided in time for use in this report.

PREHISTORIC AND HISTORIC

PREHISTORIC CULTURAL AREAS AND PERIODS

The transmission corridor study area includes sections of two major natural areas, the Great Plains and Rocky Mountains, each of which can be divided into environmental regions (Crowley 1972) that reflect limited variation on the dominant ecological theme (Figure III-23). Both major and minor ecological modifications have occurred in the area, engendered by both worldwide climatic change and localized climatic fluctuation. As a limiting and shaping factor, the environment influenced human use of the area; but, in turn, human use of the area influenced the environment as humans became an ecological element. The Native Americans of the Great Plans are sometimes called the Plains Cultural Group, and those of the Rocky Mountain area, the Plateau Cultural Group.

A reliable body of evidence indicates that approximately 10,000-15,000 years ago, during the waning phases of the Ice Age, small groups of nomadic hunters immigrated across the Bering land bridge. From the northern coastline of Alaska, some groups drifted southward into the Northern Plains through the relatively ice free McKenzie Corridor on the east flank of the Rockies between the mountain glaciers and the continental ice sheets.



ENVIRONMENTAL REGIONS OF MONTANA

SOURCE: Crowley 1972

Figure III-23

South of the continental ice sheets, in what is present day Montana, these peoples dispersed southward, eastward--and northward as the ice sheets retreated--subsisting on now extinct large mammals such as the mammoth, American horse, camel and species of bison significantly larger than the modern species. These earliest people date to approximately 12,000 years ago. Their major prey was the mammoth, their hallmark artifact was a fluted, laurel-leaf shaped spearpoint--the Clovis point--which is also the name for the archeological manifestation. Known or suspected Clovis sites in Montana are east of the Continental Divide, the mountainous areas of western Montana still being extensively glaciated at the time of Clovis occupation.

Clovis artifacts have been recovered from a site near Great Falls (Taylor 1960) and from a site near Three Forks (Taylor 1969). Others are likely within the study area from the Rocky Mountain Front eastward. In the Northwestern Plains, the Clovis tradition appears to have lasted 500-1,000 years and was followed successively by the Folsom and Plano traditions. The major diagnostic features of the Folsom tradition are an extremely well executed fluted projectile point and the hunting of the now extinct form of bison. There is an apparent increase in the usage of the Northwestern Plains during the Folsom period, but no indication of extension into the mountainous areas of western Montana.

The Plano tradition is characterized by numerous variations on a leaf-shaped unfluted projectile point form and the hunting of modern faunal species. Folsom and Plano have been found in stratified context within the study area (e.g., the MacHaffie site near Helena: Forbis 1955); surface and isolated Folsom points have been reported throughout the study area east of the Continental Divide. A Plano tradition projectile point has been documented from the Clearwater drainage west of the Divide; others are fairly reliably reported in mountainous western Montana. The Plano tradition in the Northwestern Plains extended to approximately 6,000 years ago. Therefore, by that date there was demonstrable simultaneous use of mountains and plains in the study area. Collectively, Clovis, Folsom, and Plano comprise the Early Prehistoric Period of the commonly used classification scheme for the Northwestern Plains developed by Mulloy (1958).

There is postulated a cultural hiatus of approximately 2,000 years duration in the Northwestern Plains preceding Mulloy's Middle Prehistoric Period, which began approximately 5,000-6,000 years ago. Evidence for the hiatus is not conclusive--nor particularly convincing. Abandonment of the Plains is thought to have been accompanied by an increase in use of adjacent mountainous areas. An increase in use of the mountains of western Montana has not been demonstrated to correlate with the cultural hiatus in the Great Plains.

The Middle Prehistoric Period is abundantly represented in Montana by a sequence of archeological complexes: Oxbow, Long Creek, McKean-Duncan-Hanna, Pelican Lake, and Besant. Differentiation within the period is based primarily on projectile point types. There seems to have been primary reliance on big game hunting, but artifacts associated with gathering and preparation of vegetal foods occur. Late in the period, the bison jump technique for mass slaughter became fully developed and is a significant site type of this period. There is evidence of immigration from the woodlands (Sharrock and Keyser 1974). The number of sites of this period in the study area could be realistically interpreted to reflect a growing population with varying backgrounds and cultural exchange.

The Late Prehistoric Period in the Plains began approximately A.D. 450 and lasted until the beginning of the 19th Century. During this period in the Plains, there was a marked increase in population and development of many of the characteristics normally associated with historic Plains. Bison hunting and nomadism, evidenced by the bow-and-arrow, bison jumps, travois, and tipis, typify this period. There was a proliferation of site numbers and site types, the latter associated in part with the elaboration on the basic bison hunting economy and, in part, on the diffusion of traits and immigrant populations into the area. The basic occupation pattern reflected nomadism and seasonal patterning of movements. Sedentary villages based on horticulturalism developed along the major river valleys.

In western Montana there was also an increase in population akd numbers of sites, but there is less evidence of cultural diversity than in the Plains, perhaps reflecting a less diverse ecology and a more generalized hunting and gathering economy. Plains-Plateau trade patterns were probably established in this period and are reflected in the network of trails between the Plains and Plateau that persisted into the Historic Period.

Within the study area, the Applicant's proposed route and the alternatives extend from the Pine parklands of southeastern Montana through the Beartooth Forelands, and into the Broad Valley Rockies environmental regions (Figure III-23). The Applicant's proposed route traverses the Columbia Rockies environmental region from near Ovando to the Mission Valley. The Pine Parklands, Beartooth Forelands, and Broad Valley Rockies environmental regions are all areas of high site probability. Within the Columbia Rockies region there is decreasing site probability because of heavier forestation.

Within the Pine Parklands region there is a high probability of sites, but many are apt to reflect use of short duration and to have shallow or only surface deposition. Many sites may be of a seasonal nature and/or of a limited and special use function. Temporally and spatially extensive sites are known in the area and others should exist. The Middle Prehistoric and Late Prehistoric Periods are well represented.

Within the Broad Valley Rockies there is high probability of Middle and Late Prehistoric Periods sites and significant increase in historical sites associated with mining, early day lumbering and trade and travel routes.

It should be noted that the known sites reflect sporadic and spotty cultural resource inventories. For most areas, the inventories are inadequate for an assessment of potential impact by construction associated with the selected corridor.

THE HISTORIC PERIOD

The distribution of Native American tribes during the early 19th century can be described generally. The tribes include: the Kootenai, Pend Orielles, Flatheads, Blackfeet, Bloods, Piegans, Gros Ventres, Assiniboines, and Crows. All tribes were nomadic. The Kootenai resided principally in the Kootenai River Valley, the Pend Orielle resided mainly in the southern Flathead River, and the Flathead inhabited the Bitterroot River Valley primarily. East of the Continental Divide, the Blackfeet, Blood, and Piegan lived mostly along what is now the Canadian border; but by the middle of the 18th century, they had become very mobile, and their hunting grounds consisted of the area north of the Sun River to the Canadian Border and east from the Continental Divide to the extreme easterly bend of the Missouri River. The Gros Ventres resided immediately east of the Blackfeet. The Assiniboines lived in what is presently northeastern Montana. The Crows occupied most of the Yellowstone River Valley (Toole 1959).

The introduction of the horse and gun led to an influx from all directions into the Plains of historically identifiable ethnic groups. Direct and indirect contact is indicated by artifacts manufactured by non-Native Americans. By the early 19th century, cultural diffusion had transformed Native American culture; it is at this point in time that historical records of non-Native Americans begin to provide us with knowledge of the historic landscapes of Montana, information that unfortunately lacks as much interest in Native Americans as it focuses on the activities of non-Native Americans.

Though some of Montana was explored as early as 1743 by the French voyageur Verendryes, the first significant exploration was the expedition of Lewis and Clark. By April 25, 1805, their parties were camped on the Yellowstone River. By June 13, they had reached the Great Falls. From June 21 to July 15, they portaged around the Falls. After an arduous trip up the Jefferson River with the help of the Flathead Indians, they were able to cross Lolo Pass on September 13, passing out of what is now Montana. On the return trip, they came back through Lolo Pass on June 29.

From here, Lewis took one group across the Continental Divide at the head of the Dearborn or Sun River and on to explore the Marias. Clark crossed near Gibbon's Pass, passed through Big Hole to the Three Forks area, and eventually traveled to the mouth of the Yellowstone. On August 12, the two parties joined on the Missouri (Toole 1959).

The earliest non-Native Americans to make an impact on Montana landscapes were fur traders from the Hudson's Bay Company and Northwest Fur Company. The first fur trading post was built by Manuel Lisa in 1807 at the juncture of the Yellowstone and Big Horn rivers. By 1822, Joshua Pilcher had 300 trappers trading on the upper reaches of these and other rivers. Pilcher built a second post at the mouth of the Big Horn River in 1821, near the original site of Lisa's 1807 post. In 1828, the American Fur Company, which gradually outcompeted the Rocky Mountain Fur Company, built Fort Floyd (later known as Fort Union) at the mouth of the Yellowstone River, and old Fort Union 200 miles above the mouth of the Yellowstone. In total, the Missouri Fur Company built 4 posts between 1808-1821, the Canadian Fur Company 5 posts between 1808-1846, the Rocky Mountain Fur Company 2 posts, and the American Fur Company 11 posts, with Fort Benton (1847) the only survivor (Toole 1959). Winter camps were also established, more often in areas like the Yellowstone than places such as South Pass and the Green River area. Another important settlement before the gold rush was the St. Mary's Mission built in the Bitterroot Valley by the Catholics.

The rush for gold caused many more sustained landscape changes than those induced by fur traders. There were three major gold rushes. Montana's first real strike, in July 1862 on Grasshopper Creek, a tributary to the Beaverhead River, resulted in the Bannock Rush. By the spring of 1863, there were 1,000 persons in the area. The second major rush, the Alder Gulch Rush of May 1863, occurred in the Ruby Valley, and brought 6,000 people to the area by late 1863. This gold rush culminated in the formation of Virginia City, Nevada City, Circle City, and Central City. The Last Chance Gulch Rush of December 1864 centered in the Prickly Pear Valley and the Confederate Gulch areas. It was the last of the major rushes and it culminated in the establishment of Helena.

Along the eastern slope of the Rockies, gold was discovered in Emigrant Gulch in the Yellowstone Valley. This lead to the development of Yellowstone Valley and Yellowstone City. By the early 1870's, there were 500 gold-bearing gulches being exploited. Helena and Butte were essentially mining camps-turned-towns as a result of the gold rush. In 1892, Butte was at the crest of the boom. Helena also grew, but primarily as a merchandise and banking center. In 1894, it won the fight with Anaconda for the residency of the State Capitol. However, Butte and Anaconda had the resources. The world's largest copper smelter was established in Anaconda in 1885; and after Butte's decline, Anaconda remained as core of the world's richest sources of copper.

Fur trading and the gold rush brought non-Native Americans onto the Montana landscape where their interests and values often conflicted with those of native Americans, the latter becoming involved in skirmishes with the military. The killing of Malcolm Clarke initiated the famous Piegan war of 1870. A bloody retaliation by Major Eugene M. Baker of Ft. Ellis left one-hundred and seventy-three Native Americans dead. The famous march of Chief Joseph from Oregon to Montana ended the Nez Perce's War with the Battle of the Bear Paw in October 1877. During the last half of the 19th century, military expansion and encounters on the battlefield provided those events that so dominate the historic landscape of Montana. A dozen Army forts were built between 1866 and 1892, including Forts Logan, Missoula, Keough, Custer, Assiniboine, Maginnis, and Harrison, and Camp Baker. (Toole 1959). The buffalo had been extirpated from Montana by 1881 and Native Americans were being forced onto reservations. The first reservation in Montana was the Flathead, in 1855. Between 1884 and 1914, six more reservations were established.

The economic stimulus of gold brought people. People demanded goods, resulting in a rapid rise of steamboat transportation. Soon the demand for agricultural goods induced permanent settlement of the valleys. Roads were established, initially to handle the gold traffic. The Mullan road, from Fort Benton to Walla Walla, was built in 1860. In 1864, the Bozeman route connected the Oregon trail to the Yellowstone Valley along what eventually became a train route. Another important road led from Corinne, Utah to Virginia City where it met the Union Pacific Central Railroad. Minor roads connected Virginia City to Helena, Fort Ellis to Three Forks to Helena, and Helena to Deer Lodge (see Figure III-17).

Later, railroad arteries connected Montana to the rest of the nation. The Utah Northern, a branch of the Union Pacific, met the Northern Pacific at Garrison in 1883. A railroad was also constructed from Minot, North Dakota to Helena in 1887 and continued to Everett, Washington through Marias Pass by 1893. As railroads replaced steamboats, commercial centers along rivers closed. An example is the closing of old Fort Benton after 1880.

Cattle grazing began in the 1830's and was well established by the time of the gold rush. By 1885, there were 509,968 cattle. The drought of 1886 reduced their numbers to 82,000 but by 1890 their numbers had increased again.

The sheep industry began later. The first big drive from The Dalles, Oregon to Dixon moved 1,500 sheep in 1869. By 1885, there were 593,896 sheep. Although affected by the drought, there were 1,555,116 sheep in Montana in 1890, and Billings was the center of activity. Six million sheep grazed in Montana at the turn of the century, more than in any other state. The boom ended in 1910 (Toole 1959).

The wet years of the early 1880's encouraged small islands of agricultural settlement, especially around Glendive, Miles City, Billings, and into northeast Montana. The original settlers were mostly Slav and Swedish immigrants from the Middle Western States. By 1922, 93,000,000 acres, or 40%, of the state's land had been settled. However, drought came between 1917 and 1925 and again sporadically between 1929 and 1939. Consequently, there is evidence of many agricultural failures.

From known historic sites in the study area, a few particularly sensitive areas can be designated. They are (1) an area 10-15 miles east of Broadview, (2) the Helena area, and (3) the Missoula area.

VISUAL

Montana contains spectacular and unspoiled country that inspires pride in many Montanans and attracts sightseers and outdoor enthusiasts from across the nation. The study area includes significant portions of these visual resources. Four types of information are important in assessing visual impacts: landscape character subtypes, vegetation types, scenic quality, and visual sensitivity. Landscape character subtypes and vegetation are used to predict visual contrasts. Landscape character subtypes are also used to identify similar landscapes which are then compared against each other to determine relative scenic quality. Scenic quality and visual sensitivity are used to assign Visual Resource Management Classes. Each of these four types of information contributes to an overall understanding of how visually incompatible transmission lines would be in a particular landscape. Existing vegetation is discussed in the "Vegetation" section of this chapter; landscape character types and subtypes, scenic quality and visual sensitivity are discussed below.

LANDSCAPE CHARACTER TYPES AND SUBTYPES

The study area contains portions of two physiographic regions--the Northern Rocky Mountains and Great Plains (Wirth 1977).

Northern Rocky Mountains

The western half of the study area consists of high rugged mountain ranges embracing broad fertile valleys. These ranges are a series of individual parallel ridges trending northwest to southeast. They are up to 20 miles wide and between 50 and 100 miles long. They often rise more than 5,000 feet above the valley floors to reach elevations approaching 10,000 feet. The region's rivers flow at elevations of 3,000 to 5,000 feet; their valleys are typically 5 to 20 miles wide and 25 to 75 miles long (Perry 1962).

Great Plains

The Great Plains dominate the eastern portion of the study area. They do not, however, resemble the smooth flat expanses generally associated with the term. Within the study area, the Plains are classified as plateaus-and-hills, this being part of the roughest portion of the Great Plains. Where genuine plains do occur, they are either irregular or have on them widely spaced, isolated mountains or hills, such as the Big Snowy and Little Belts. These mountains typically have broad rounded crests and steep-sided valleys and rise 2,000 to 4,000 feet above the surrounding plains.

Figure III-24 locates the Northern Rocky Mountains and the Great Plains, as divided into landscape subtypes.

SCENIC QUALITY

Within each landscape character subtype, scenic quality classes ranging from A+ (distinctive) to C- (degraded) are described and mapped.

Scenic quality classes are described in Appendix A-4 on Table A-4-1 and their distributions are shown in Figure III-25. The analysis shows that most of the study area's A+ and A quality landscapes occur in mountainous areas. The Mission and Anaconda Ranges contain the only A+ lands, although concentrations of outstanding (A) scenery also exist in the mountains both W-NW and N-NE of Missoula, on both sides of the Continental Divide, in the Elkhorns south of Helena, in the Bull Mountain area, and in the Crazy Mountains. In the eastern portion of the study area, small areas of A scenery occur as ribbons along rivers and streams.

VISUAL SENSITIVITY

Figure III-26 contains two types of information about existing visual sensitivity:

1. It displays the viewsheds (seen areas) of roads and use areas; and

2. It classifies the above viewsheds into appropriate sensitivity levels according to distance and user importance, as discussed in Chapter IV.

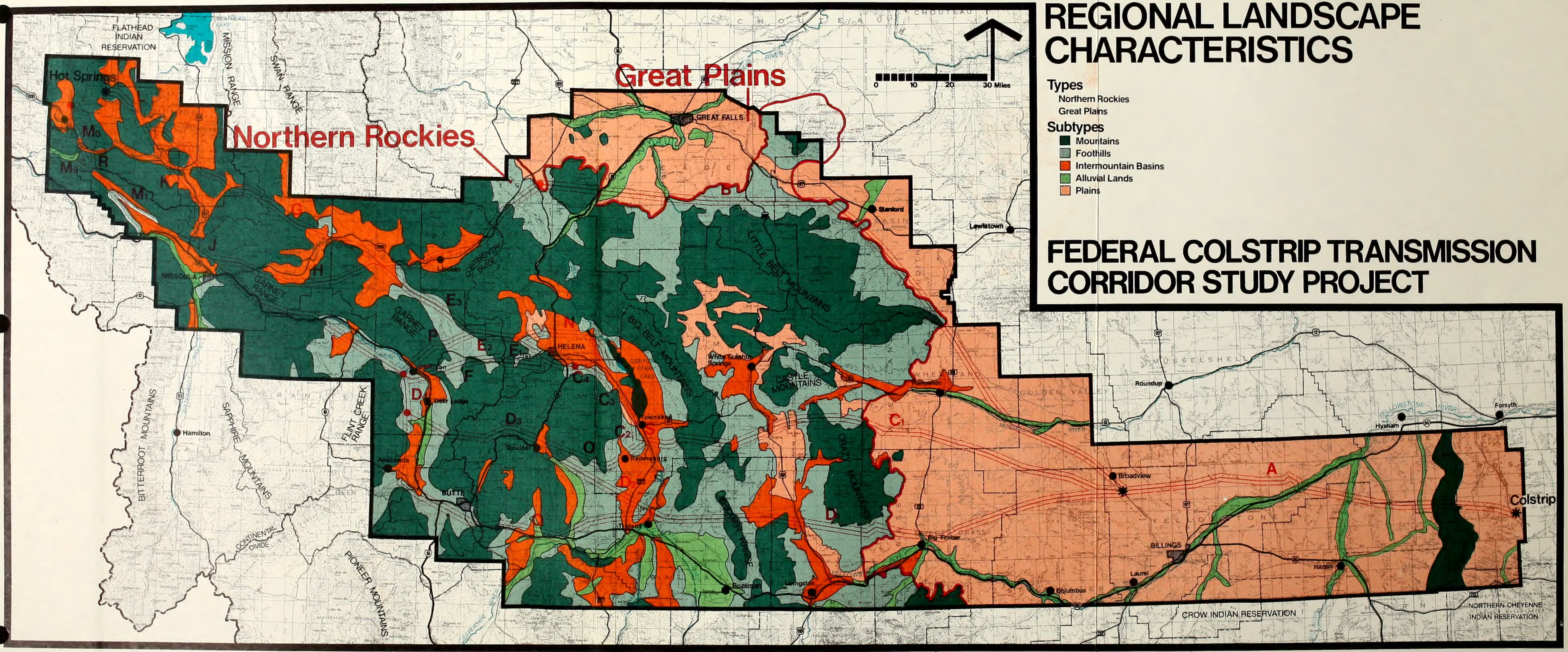
Sensitivity Levels

Perceptions of transmission lines as inappropriate are assumed to vary with differences in land uses and roads. Areas seen from selected land uses and roads are classified, in order of decreasing sensitivity, as:

Special Areas - Includes roadless areas, wilderness areas, primitive areas, and proposed wilderness. Most special areas within the study area occur in mountainous western areas.

Level One - Includes land uses dependent on natural settings, high volume roads, pipe-irrigated agricultural lands, and urban and suburban areas. Less travelled areas seen from a Level One area are mapped as Level One. Generally, in the Rocky Mountain portion of the study area, most dwellings and north-south highways are in river valleys. East-west highways climb out of the valleys through infrequent mountain passes (i.e., Homestake and MacDonald Passes). As a result, in the western part of the study area, most valleys and major passes have Level One sensitivity. Larger and more frequent Level One areas exist in the plains where terrain does not limit road building or views as severely.

Level Two - Consists of areas visible from commercial air routes, flood-irrigated agricultural lands and areas of dispersed use (i.e., back country portions of state forests, BLM, National Forest lands, and wildlife management areas). In the Plains, most Level Two areas are within Level One viewsheds and are, therefore, mapped as Level One. In the mountains, Level Two areas are often screened from view of Level One observers and are, therefore, more numerous than Level Two areas in the Plains.



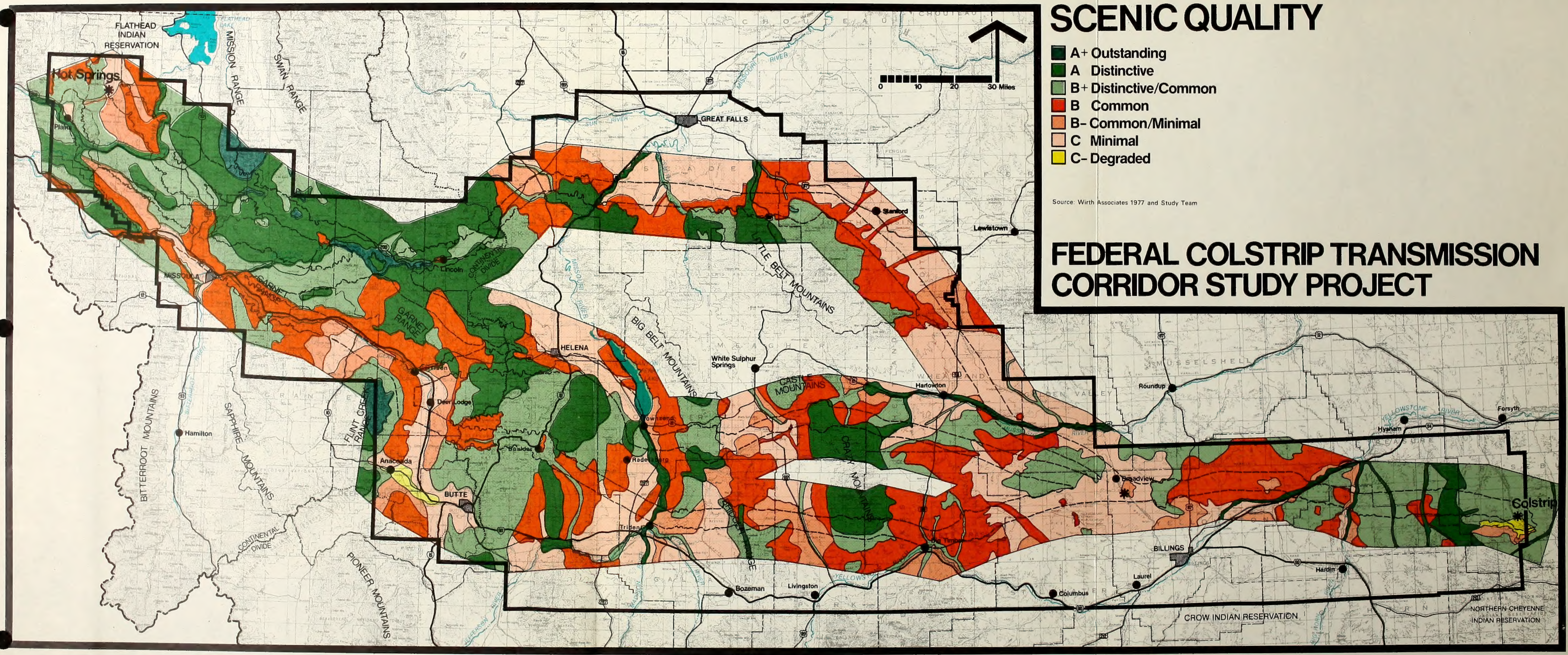
REGIONAL LANDSCAPE CHARACTERISTICS

Types
- Northern Rockies
- Great Plains

Subtypes
- 🟩 Mountains
- ▨ Foothills
- 🟥 Intermountain Basins
- 🟩 Alluvial Lands
- ▨ Plains

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-24



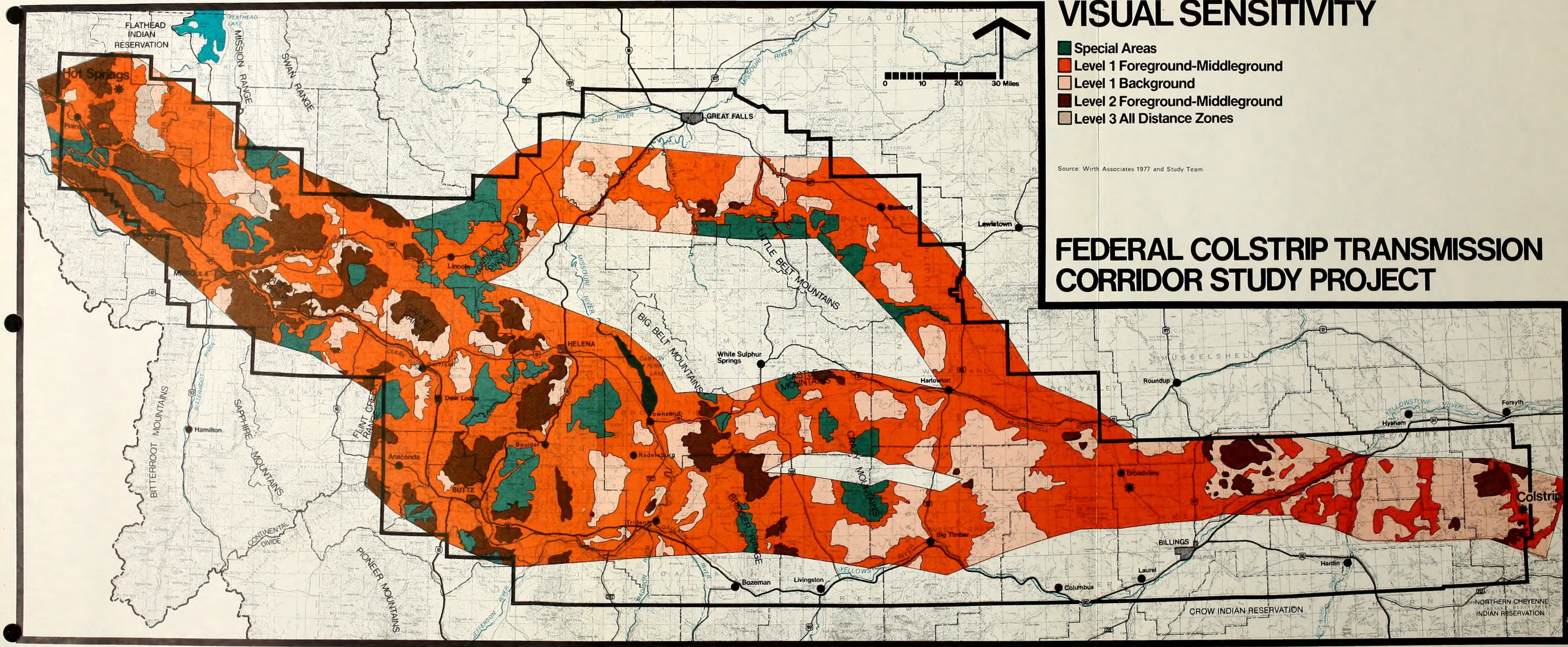
SCENIC QUALITY

- 🟩 A+ Outstanding
- 🟩 A Distinctive
- 🟩 B+ Distinctive/Common
- 🟥 B Common
- 🟧 B- Common/Minimal
- ▨ C Minimal
- 🟨 C- Degraded

Source: Wirth Associates 1977 and Study Team

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-25



VISUAL SENSITIVITY

- 🟩 Special Areas
- 🟥 Level 1 Foreground-Middleground
- ▨ Level 1 Background
- ■ Level 2 Foreground-Middleground
- ▨ Level 3 All Distance Zones

Source: Wirth Associates 1977 and Study Team

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure III-26

Level Three - Consists all seldom seen areas including most of the dryland agricultural areas.

Distance Zones

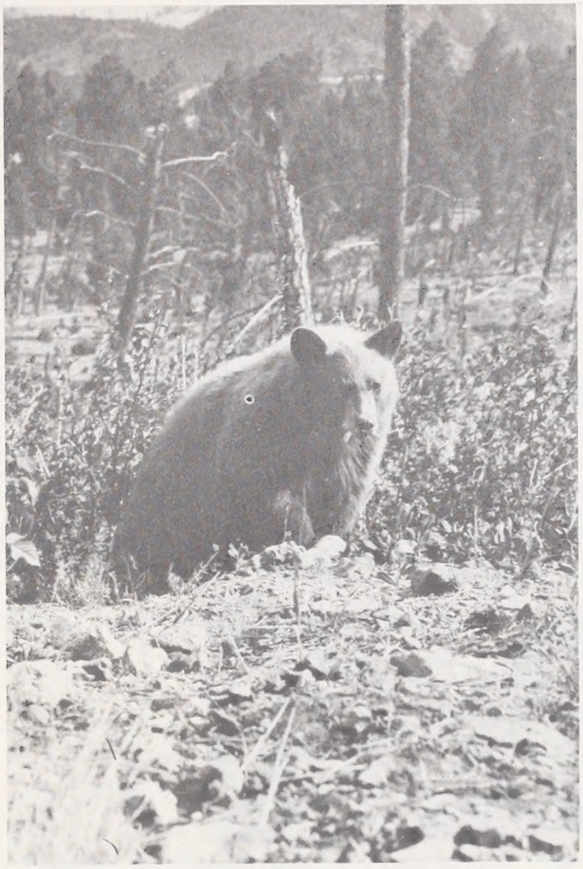
The observer distance also determines how visually sensitive a piece of land is; consequently for this study, seen areas were divided into distance zones:

Foreground/Middleground: The visible zone from a road or other observer point up to five miles. Details of management activities are easily discerned in this zone.

Background: The visible zone beyond the Foreground/Middleground, usually between five and fifteen miles away from a road or other observer point. Details of management activities are not easily discernible in this zone.

Seldom Seen: All areas not identified in the previous two zones, generally areas more than fifteen miles from a road or use area, or areas completely hidden from view by topography or vegetative barriers.

In the western part of the study area, Level One Foreground/Middleground zones are concentrated in the valleys where most of the roads and use areas are; background zones generally extend only to the crest of the mountain ranges. In the Plains portion of the study area, topographic barriers to views are not frequent or severe; consequently, large background zones are common.



Adult black bear (Montana Fish and Game Dept. photo).

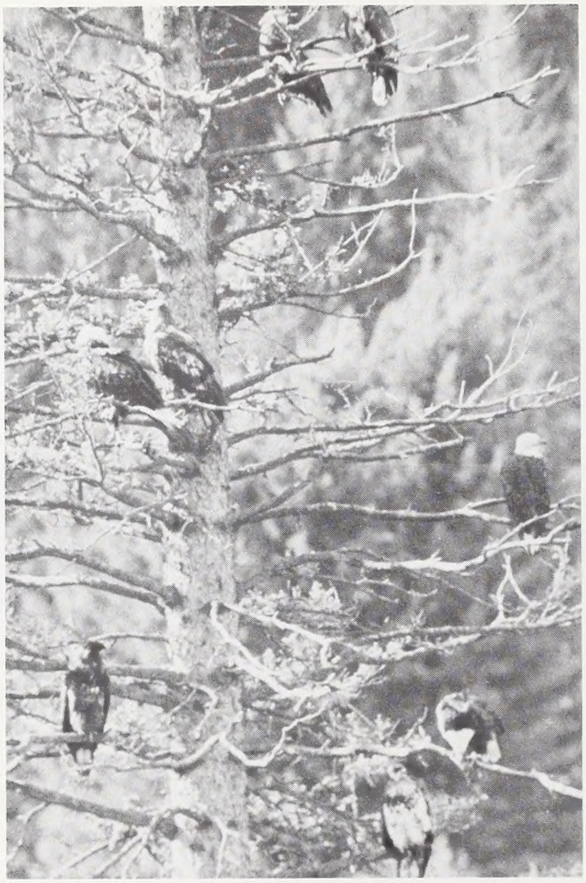
Black bear cub (Montana Fish and Game Dept. photo).

Mule deer (Montana Fish and Game Dept. photo).

Black-footed ferret (Montana Fish and Game Dept. photo).

Grizzly bear (Montana Fish and Game Dept. photo).

Bald eagle (juvenile stage). Montana Fish and Game Dept. photo).

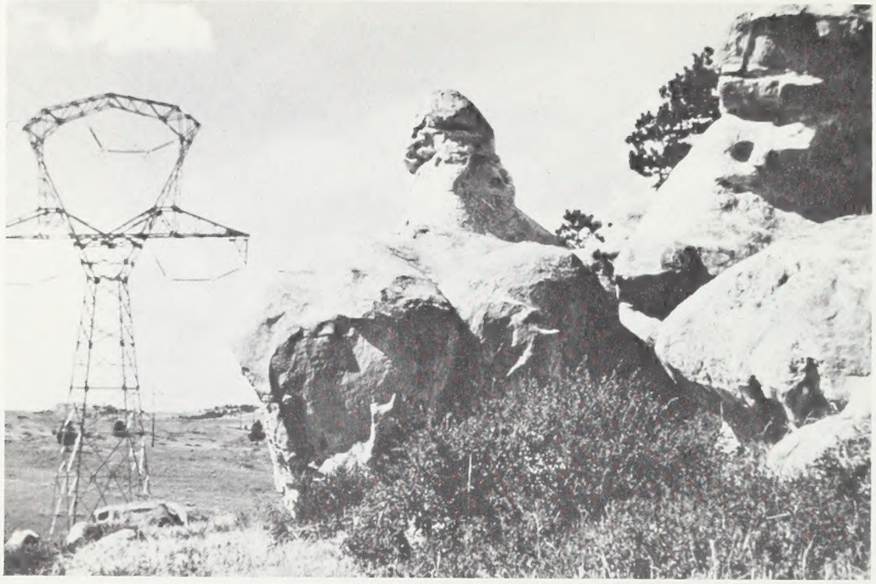


Bald eagles (Montana Fish and Game Dept. photo).

Boating and waterskiing scene on Canyon Ferry Lake (Montana Fish and Game Dept. photo).

Applicant's proposed corridor in the vicinity of the northern section of RARE II Area No. 1-742 looking southwest into the head of Deer Creek (Montana Dept. of Natural Resources photo).

Blackfoot River scene approximately eight miles west of Potomac, Montana, on State Highway 200 (BLM photo).



Rock outcrop encountered by existing Colstrip to Broadview 230 kV line in eastern Montana (Montana DNRC photo).

View to east along Applicant's corridor where it would cross east side of Big Coule south of Ryegate, Montana (Montana DNRC photo).

SEGMENT ANALYSIS AND EVALUATION

(STEP 1)

SEGMENT ANALYSIS AND EVALUATION
(STEP 1)

OBJECTIVES

1. Develop plans-of-service for Helena, Great Falls, and Butte-Anaconda by identifying corridor segments for each.

2. Develop a methodology for corridor segment analysis and evaluation.

3. Eliminate the least desirable corridor segments for each plan-of-service. Retain the Applicant's proposed corridor and their alternative around the Flathead Indian Reservation for comparative analysis and evaluation.

ORIGIN OF CORRIDOR SEGMENTS AND THEIR RELATIONSHIP TO PLANS-OF-SERVICE

ORIGIN OF CORRIDOR SEGMENTS

The corridor segments to be analyzed by the Colstrip Transmission Study Team had been originated and described previously in two reports. Most segments were developed and described in the Westinghouse Report (WESD/AEA 1973) and additional ones were added for comparison by the Montana Department of Natural Resources and Conservation (DNRC) for consideration in their EIS (DNRC/DEIS 1974). The segment origin map (Figure IV-1) illustrates which segments were derived from each of these reports, and shows their approximate locations within the study area.

The Applicant's proposed corridor, as shown on this map, was located, using the latest information available from strip maps furnished by the Montana Power Company. These strip maps were being used for their centerline studies. Alternate corridor segments to the Applicant's proposed corridor, including corridor segments around the Flathead Indian Reservation, were mapped as described in the Westinghouse Report and displayed in Figure 3.3-3 (p. 3-9) of that report. Segments developed by the Montana State DNRC were located approximately as shown in Montana State's draft EIS and mapped via a reference route on USGS quads at a scale of 1:250,000.

No new segments were developed by the Colstrip Transmission Study Team at this stage. Only for Step 3 analysis, wherein problem areas were identified by Federal land management agencies, were new corridors developed. This approach was reviewed and approved by officials of the U.S. Department of Interior at the Washington, D.C. level at a meeting held on August 5, 1977 (Wilkerson 8/17/77; see Appendix F).

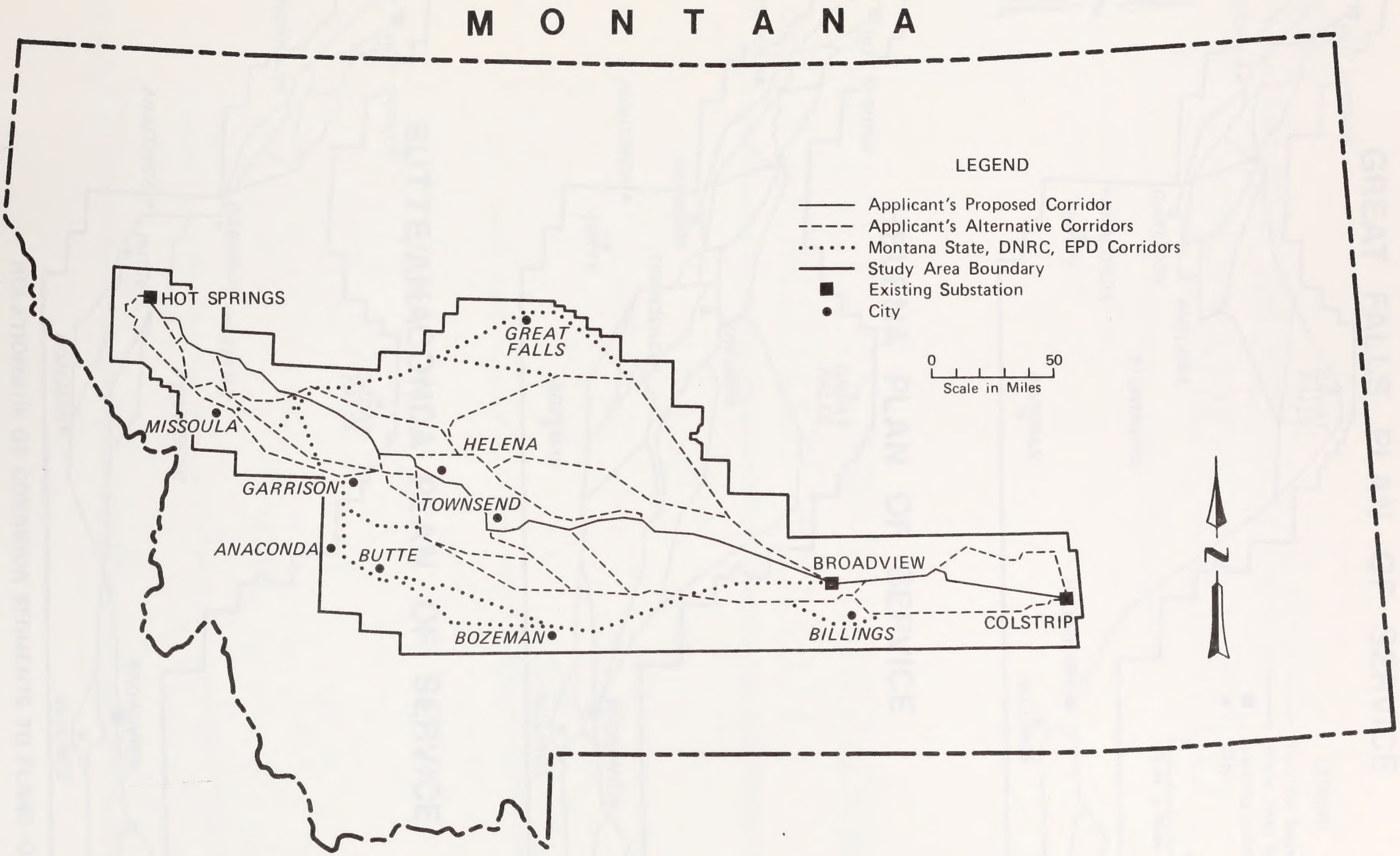
RELATIONSHIP BETWEEN PLANS-OF-SERVICE AND CORRIDOR SEGMENTS

Segments which could serve as logical portions of three different plans-of-service were identified by the Systems Engineer assigned to work with the Study Team (see Figure IV-2). The rationale for including segments as parts of each plan-of-service is discussed under "Feasible Electric Plans-of-Service" in Chapter II.

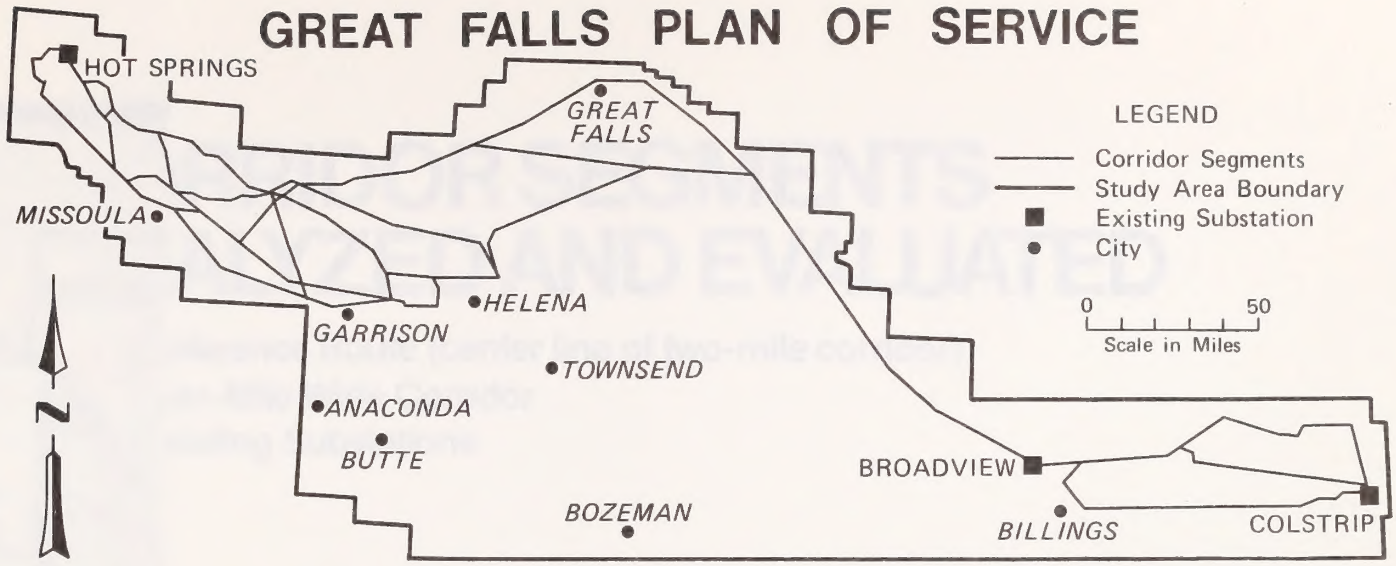
PROCEDURE

METHODOLOGY

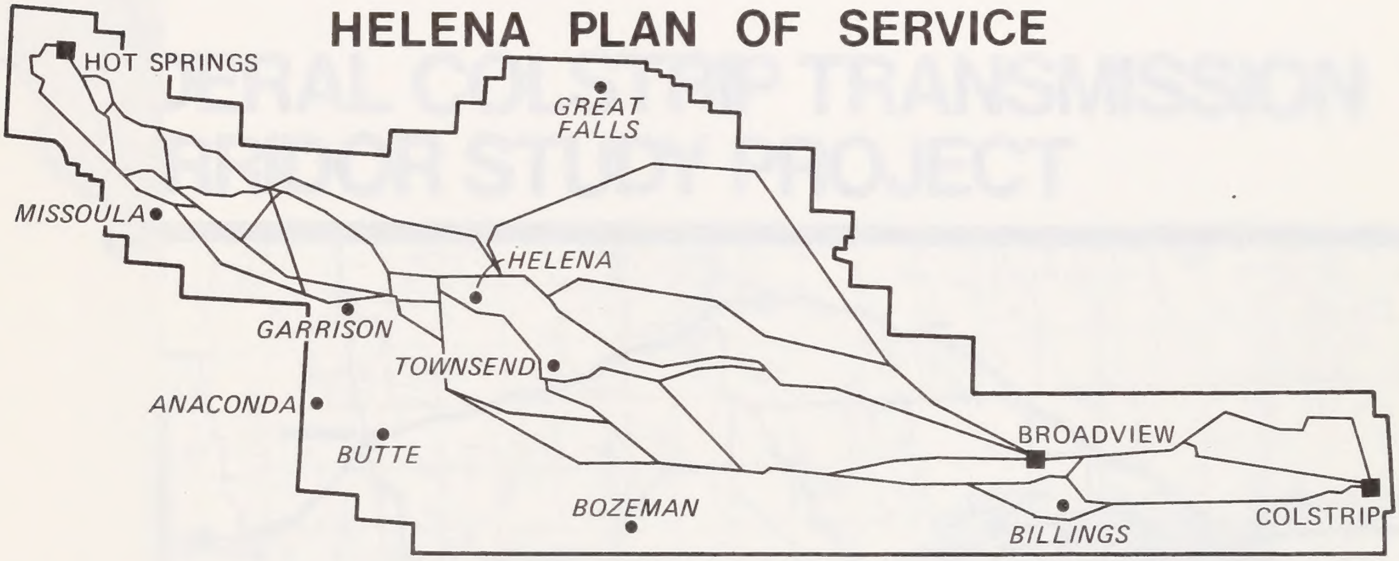
The Colstrip Transmission Study Team was to analyze and compare corridor segments from the large network of segments previously identified which could accommodate transmission facilities from Colstrip to Hot Springs (see Figure IV-3). Transmission corridors were to be developed and analyzed comparatively for impacts on the study area's existing environment. The number of different corridors which could be created from this network of 84 segments is very large, and it was obvious that a complete detailed analysis of _all_ segments and potential corridors would not be practical for this study. Corridor segments that did not warrant detailed study because of their obvious economical, technical, and/or environmental infeasibility or undesirability needed to be eliminated early in the analysis process. Consequently, a reliable procedure was needed to identify segments which would create the largest adverse impact on the



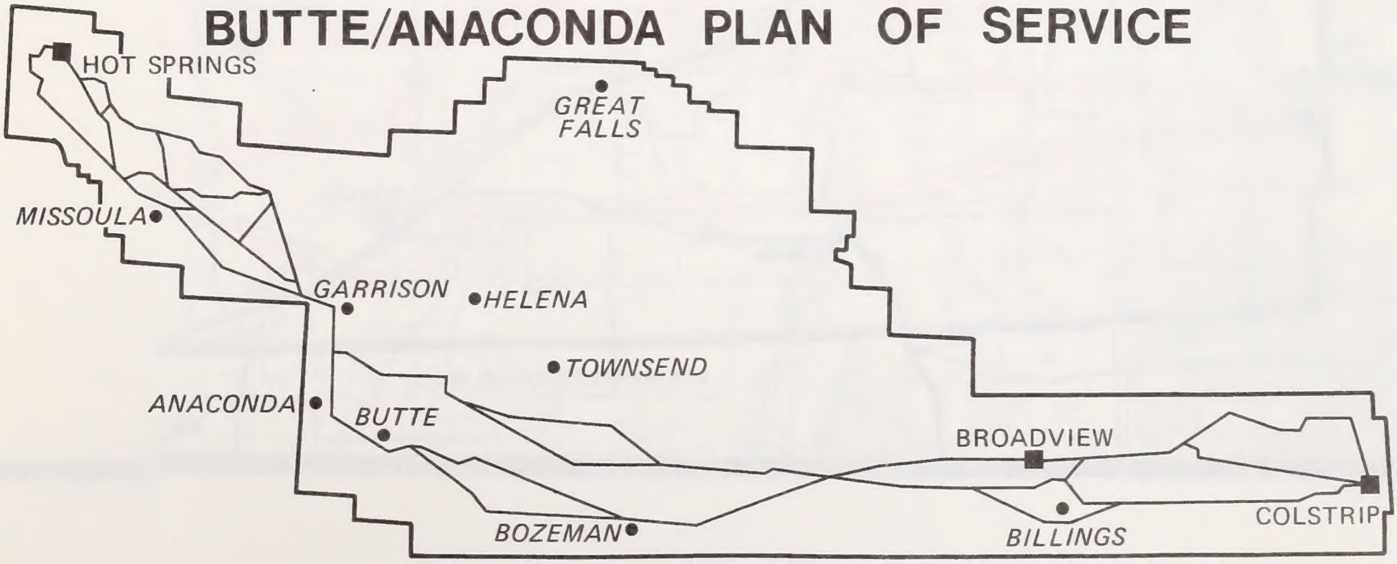
ORIGIN OF CORRIDOR SEGMENTS
Figure IV-1



GREAT FALLS PLAN OF SERVICE

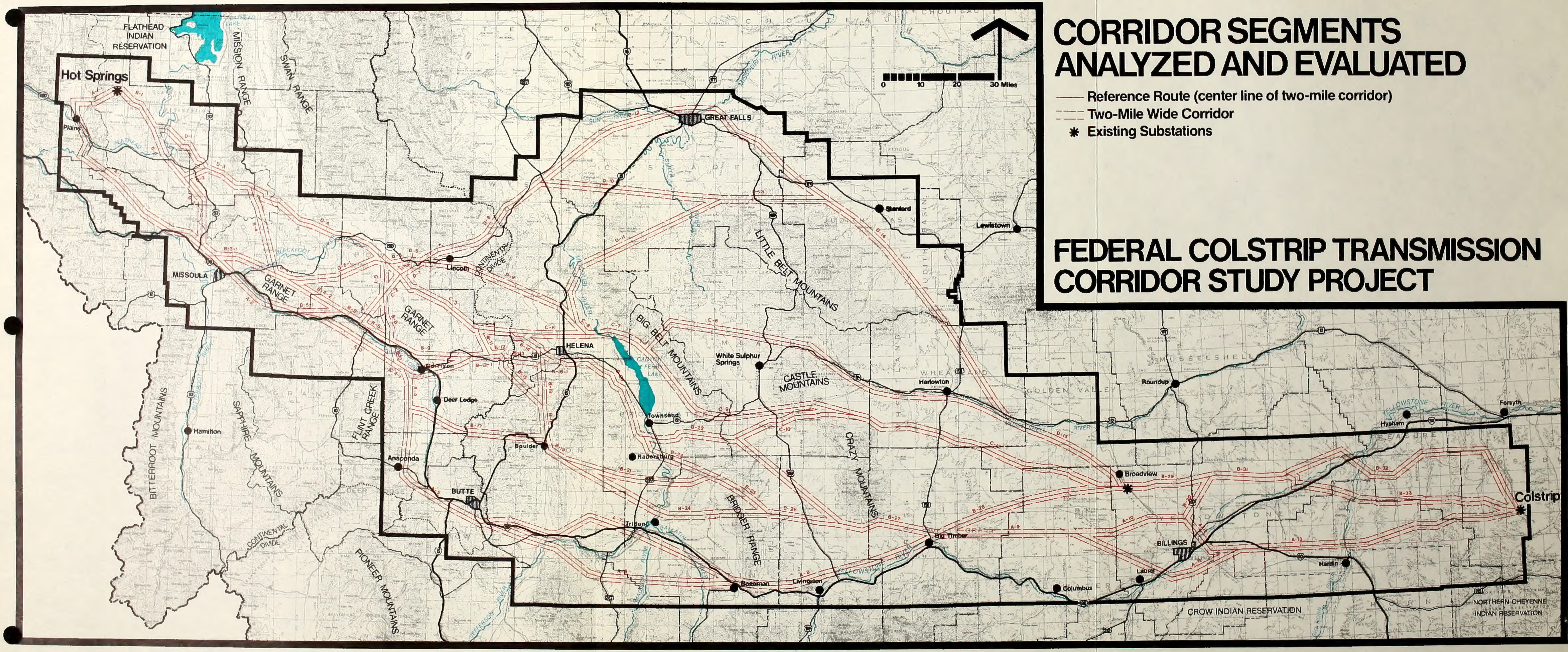


HELENA PLAN OF SERVICE



BUTTE/ANACONDA PLAN OF SERVICE

RELATIONSHIP OF CORRIDOR SEGMENTS TO PLANS–OF–SERVICE
Figure IV-2



CORRIDOR SEGMENTS ANALYZED AND EVALUATED

- Reference Route (center line of two-mile corridor)
- Two-Mile Wide Corridor
- ✱ Existing Substations

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure IV-3

environment so they could be dropped from further consideration. In addition, a procedure that would be useful, with appropriate variations, for detailed analysis of the remaining more environmentally feasible segments and corridors was desirable.

Much of the available information pertaining to the existing environment of the study area was descriptive and could not be used directly to comprehensively compare various segments. Even quantitative data would have limited usefulness for this purpose, unless they could be related to the occurrence of an environmental impact. Also, the desired procedure had to be applicable to data and information which could be quickly developed from available sources. Within this set of conditions, the Study Team devised a procedure for converting environmental information from a wide variety of resources into number values. These values would allow direct comparison of estimated potential impacts on the resources within each segment from the introduction of power transmission facilities.

The basic principles for this procedure were developed by VTN Consolidated, Inc. in association with Comitta Frederick Associates, and described in Assessment of Alternative Power Transmission Corridors for the Dickey/Lincoln School Hydroelectric Project (USDI 1976b). This study had somewhat different initial objectives, but its methodology provided an approach which could be modified for application to the Colstrip Transmission Corridor Study Project.

A required feature of any method used to measure impacts involving transmission facilities is the identification of environmental resources that may be subject to impacts. The unique feature of the procedure developed in this instance is that it provides an estimate of the seriousness and importance of potential impacts on a wide range of resources by assigning number analogs to different components of each resource. Each major environmental resource which the Study Team felt had a reasonable chance of being impacted by the proposed action is referred to as a determinant. Each determinant was considered to be composed of various lesser or more specific resources termed data items. Each of these is a factor considered as a constraint to the introduction of transmission facilities. In other words, the possibility of environmental impacts on these resources limits the usefulness (or desirability) of certain areas for transmission facility location.

It should be pointed out that certain data item components of some determinants were also used as determinants themselves. This resulted from considering different aspects of the particular resource in different ways. For example, Agricultural Land is a data item for the determinant Vegetative Cover because it presents a specific portion of this vegetation resource. Furthermore, Agricultural Land is a major resource of the study area which is subject to impacts, so it also warrants full consideration as a determinant. Figure IV-4 illustrates the breakdown of determinants and data items. Each determinant and associated data item, as shown in this matrix, is discussed later in this chapter. Details on the significance of numbers and letters on this matrix are developed below.

The judicious assignment of numbers to resources (as broken down into determinants and data items), combined with a unit number or distance measurement across which the resource is influenced, provide a basis for developing comparative estimates of the severity of impact for each segment. For this approach to be used, the geographic distribution, within the study area, of each resource of importance must be known. Hence, only "mappable" resources can be utilized. Mapping such resource data and information will show locations, distributions and concentration of resources, and thus provide indications of "sensitive areas." In this sense, "sensitivity" includes: (1) locations of "critical" resources which would likely be severely impacted; and (2) locations of environmental areas within which a number of resources share the same space. Having more than one resource which may be impacted in a given location increases the potential for environmental degradation. Thus, increased sensitivity connotes increased probability that a high impact would occur in that area if transmission facilities are introduced.

Number values which relate to the sensitivity of resources were derived by placing each data item into a low, medium or high category, based on the Study Team's estimate of the seriousness of the impact likely to occur on each data item. Each successively higher category was considered to be approximately twice as potentially detrimental in impact as the one before it. Therefore, number analogs of 1, 2, and 4 were assigned to the low, medium and high categories, respectively.

The determinant Vegetative Cover illustrates this. Vegetation is a known mappable resource which has a high probability of being impacted by introduction of power transmission facilities. Comprising this determinant are the data items Agricultural Land, Rangeland, Forest Land, Threatened and Endangered Plant Species, and Wetlands. The Agricultural Land component of Vegetative Cover represents an already disturbed vegetation situation. It is a highly managed vegetation system where vegetative recovery would represent a minimum problem. Therefore, impacts on agricultural vegetative cover would not be very serious. Thus it was assigned a low rating with a number analog of 1. The natural condition of Rangeland vegetation is more sensitive to disruption and has related recoverability problems, so it was rated medium for seriousness of impact, or 2. Forest Land vegetation would be completely changed in almost the entire right-of-way for as long as the corridor would be maintained in service, so its sensitivity or seriousness rating is high with a corresponding number analog of 4. Likewise, any Threatened or Endangered Plant Species or Wetlands vegetation would be seriously impacted if disrupted by activities related to a power transmission corridor, so they were rated 4. Thus each L, M, or H (low, medium, or high) symbol in the Step 1 matrix (Figure IV-4) refers to the relative seriousness of an impact on each of these data items. To calculate impact scores, the number analog (1, 2, or 4) is used to represent this seriousness rating (see the impact formulas, this chapter).

To supplement the impact scores developed in this manner, certain quantitative data relating to most data items are displayed in an accompanying table, as Segment Supplemental Quantitative Information (see Table IV-6). These data generally represent important portions of the total information base used in developing the impact ratings for each data item listed.

The first step in converting the mapped resource information to impact scores was to superimpose a corridor segment map over each data item map. The length, in miles, each corridor segment coincided with or crossed mapped data items was recorded. Each level of sensitivity (low, medium and high) was measured separately, and results were multiplied by its corresponding number analog (1, 2, or 4, respectively). The sum of these values for each data item represents the data item impact score for the corridor segment being measured.

Using distance measurements (miles) as a basis for impact estimates has the advantage of relating impacts to corridor or segment lengths. This helps to account for the greater potential impacts on longer segments, thus favoring shorter corridors if there is a difference in sensitivity between segments. However, only those determinants which are continuous over all land areas, such as Land Suitability or Visual Sensitivity, exhibit this advantage. Other determinants, such as Agricultural Land and Commercial Forest Land, are discontinuous and the area covered by them is not necessarily related to segment length. Still other determinants relate to point or number data (e.g., Prehistoric and Historic Sites and Human Population) and required special development. Some determinants represent a single identifiable resource, whereas others, such as Wildlife, are composed of a variety of resources. Due to the variety of resources included in this analysis, much variation in the development process was required, as discussed in the following section.

An additional advantage of estimating impacts in relation to distance is that the impact score per mile of segment can be calculated. The magnitude of this value indicates the suitability of various areas within the study area for electric transmission facilities. In certain instances, longer segments may be preferred if they avoid areas crossed by shorter segments which may have particularly high impact scores per mile.

One additional quantitative adjustment was required to make this procedure viable. A weighting of determinants was necessary to account for the relative importance of different resources. This adjustment was made by assigning a weight of 1, 2, or 3 to each determinant and multiplying the data item impact score for each determinant by its appropriate weight

Data Item Weights - H=4, M=2, L=1

RESOURCE DATA ITEMS

DETERMINANTS	WEIGHTS	LAND SUITABILITY			SURFACE WATER			FISH AND WILDLIFE			
		Good	Fair	Poor	Sediment Risk - High	Sediment Risk - Medium	Sediment Risk - Low	High Impact Potential	Medium Impact Potential	Low Impact Potential	Threatened and Endangered Animal Species
FISH AND WILDLIFE	2							H	M	L	H
LAND SUITABILITY	2	L	M	H							
SURFACE WATER	1				H	M	L				
VEGETATIVE COVER	2										
UNIQUE NATURAL RESOURCES	3										H
AGRICULTURAL LAND	2										
COMMERCIAL FOREST LAND	3										
RANGELAND	1										
RECREATION RESOURCES	2										
LAND MANAGEMENT PLANS	–										
PREHISTORIC AND HISTORIC	2										
HUMAN POPULATION	2										
SCENIC QUALITY	3										
VISUAL SENSITIVITY	3										
LEGAL CONSTRAINTS	–										■

DETERMINANTS	WEIGHTS	VEGETATION												
		Agricultural Land			Rangeland			Forest Land						
		Irrigated Land	Prime and Unique Farm Lands	Dry Land Farming	Good Productivity/Poor Recoverability	Fair Productivity/Fair Recoverability	Poor Productivity/Good Recoverability	Cool & Moist - Cold & Moderately Dry	Moderately Warm & Dry - Moderately Cool & Moist	Warm & Dry	Warm & Very Dry	Varied Climate	Threatened and Endangered Plant Species	Wetlands
FISH AND WILDLIFE	2													H
LAND SUITABILITY	2													
SURFACE WATER	1													H
VEGETATIVE COVER	2	L	L	L	M	M	M	H	H	H	H	H	H	H
UNIQUE NATURAL RESOURCES	3												H	H
AGRICULTURAL LAND	2	H	H	M										
COMMERCIAL FOREST LAND	3								H	M	L	L		
RANGELAND	1				H	M	L							
RECREATION RESOURCES	2													
LAND MANAGEMENT PLANS	–													
PREHISTORIC AND HISTORIC	2													
HUMAN POPULATION	2													
SCENIC QUALITY	3													
VISUAL SENSITIVITY	3													
LEGAL CONSTRAINTS	–												■	

DETERMINANTS	WEIGHTS	SPECIALLY MANAGED AREAS										RECREATION SUITABILITY		
		Wilderness/Primative	New Wilderness Study Areas	Roadless Areas (Includes Essentially Roadless)	Natural Areas (Pristine, Relict, Geologic, Scenic and Landmarks)	Game Refuges and Ranges	State Parks and Recreation Areas	Wild and Scenic Rivers	Scenic Travelways	Recreation Waterways	Management Objectives for Specified Areas	High Impact Potential	Medium Impact Potential	Low Impact Potential
FISH AND WILDLIFE	2					H								
LAND SUITABILITY	2													
SURFACE WATER	1													
VEGETATIVE COVER	2													
UNIQUE NATURAL RESOURCES	3	H	H	L	H		M	H						
AGRICULTURAL LAND	2													
COMMERCIAL FOREST LAND	3													
RANGELAND	1													
RECREATION RESOURCES	2											H	M	L
LAND MANAGEMENT PLANS	–	■	■	■	■	■	■	■	■	■	■			
PREHISTORIC AND HISTORIC	2													
HUMAN POPULATION	2													
SCENIC QUALITY	3													
VISUAL SENSITIVITY	3								H	H				
LEGAL CONSTRAINTS	–				■			■						

DETERMINANTS	WEIGHTS	PREHISTORIC AND HISTORIC				VISUAL						POPULATION DENSITY AND PROXIMITY			
						Scenic Quality			Visual Sensitivity						
		National Register Sites and Trails	High Sensitivity Zone	Medium Sensitivity Zone	Low Sensitivity Zone	Level 1	Level 2	Level 3	High	Medium	Low	<49 Persons Per Square Mile	5 – 49 Persons Per Square Mile	>5 Persons Per Square Mile	Pop. Ctr. Crossed by or within 1 Mi. of Corr.
FISH AND WILDLIFE	2														
LAND SUITABILITY	2														
SURFACE WATER	1														
VEGETATIVE COVER	2														
UNIQUE NATURAL RESOURCES	3														
AGRICULTURAL LAND	2														
COMMERCIAL FOREST LAND	3														
RANGELAND	1														
RECREATION RESOURCES	2														
LAND MANAGEMENT PLANS	–														
PREHISTORIC AND HISTORIC	2	H	H	M	L										
HUMAN POPULATION	2											H	M	L	H
SCENIC QUALITY	3					H	M	L							
VISUAL SENSITIVITY	3								H	M	L				
LEGAL CONSTRAINTS	–	■													

SEGMENT ANALYSIS AND EVALUATION MATRIX
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
Figure IV-4

(see Figure IV-4). Thus, both the *sensitivity* of a resource to potential impacts, plus the *importance* of that resource are accounted for in the analysis. Weighting of determinants is discussed under "Determinants and Data Items" in this chapter.

Derivation of impact scores may be expressed as follows:

$$\left[\begin{matrix}\text{Mi of }\underline{\text{High}}\\ \text{Data Items}\end{matrix} \times 4\right] + \left[\begin{matrix}\text{Mi of }\underline{\text{Medium}}\\ \text{Data Items}\end{matrix} \times 2\right] + \left[\begin{matrix}\text{Mi of }\underline{\text{Low}}\\ \text{Data Items}\end{matrix}\right] = \begin{matrix}\text{Data Item}\\ \text{Impact Score}\end{matrix}$$

and:

$$\left[\begin{matrix}\text{Data Item}\\ \text{Impact Score}\end{matrix}\right] \times \left[\begin{matrix}\text{Determinant Weight}\\ \text{Factor (1, 2, or 3)}\end{matrix}\right] = \begin{matrix}\text{Determinant Segment}\\ \text{Impact Score}\end{matrix}$$

or, in general terms:

$$\left[\begin{matrix}\text{Distance of}\\ \text{Impact Effect}\end{matrix}\right] \times \left[\begin{matrix}\text{Seriousness}\\ \text{of Impact}\end{matrix}\right] \times \left[\begin{matrix}\text{Importance}\\ \text{of Resource}\end{matrix}\right] = \begin{matrix}\text{Resource Impact}\\ \text{Score of Segment}\end{matrix}$$

Finally, the sum of *all* determinant segment impact scores for any segment equals the *Total Segment Impact Score*.

Table IV-5 lists all *Determinant* and *Total Segment Impact* scores for each of the 84 segments analyzed. Comparing total segment impact scores of segments which could connect the same two points reveals which one would cause the more serious environmental degradation. Segments with highest total impact scores cross the least desirable areas for introduction of transmission facilities and should be avoided in favor of segments with lower impact scores.

The analysis was expanded to compare combinations of segments (called *links*) which connect two more widely separated points. This was done by adding total segment impact scores for all the segments in a link.

Impact scores of equivalent links were then compared to reveal least-impact links. Likewise, entire corridors could be compared by summing the segment impact scores for all segments in a corridor.

Step 1 segment analysis and evaluation employed this methodology. Total segment impact scores were derived using resource information that was either already available or readily developed. Segments with the highest impacts were eliminated to identify least-impact corridors for each of the three plans-of-service (i.e., Great Falls, Helena and Butte-Anaconda). The Applicant's proposed corridor and their proposed alternative around the Flathead Indian Reservation (the Siegel Pass Alternative) were retained for comparison in later steps of the analysis, regardless of their impact scores. The segment comparisons are detailed under "Results" in this chapter.

This methodology was also used to evaluate segments and corridors in Steps 2 and 3. In many cases, more detailed data were developed for these steps and some of the determinants and data items were further refined. Slight alterations in procedure were made as required for the different conditions and objectives of these later steps. Specific changes are discussed in those chapters of this report.

DETERMINANTS

Determinants are major categories of resources considered to be subject to potential impact resulting from the construction, operation, and maintenance of two 500-kV electric transmission lines. The list of determinants is limited to those resource categories which the Study Team felt could receive impacts of reasonable magnitude. Determinants can be composed of one or more data item; any data item can be used in more than one determinant (see Figure IV-4).

Although all of the resource categories listed as determinants are considered to be important and to have a reasonable potential to be impacted, they are not equally important or sensitive to being impacted. Thus, the determinants were weighted relative to each other by using the values of 1, 2, and 3. A determinant with a weight of 3 had more ultimate influence on total impact scores than a determinant with a weight of 2, and a weight of 2 was more influential than a weight of 1.

The Study Team used the responses of the state's public opinion surveys and its own professional judgment to assign determinant weights. Special attention was given to resource categories which the public considered to be important, although such public opinion of resource importance was tempered by the team's evaluation of impact potential. The impact analysis was based on the assumption that construction techniques commonly used today would be used for the installation of the proposed power lines, including road access to the right-of-way so that ground equipment could be used in clearing, constructing towers, and stringing the conductors.

A list of the determinants used for Step 1 analysis purposes and their relative importance weights follows:

Natural	Weights*
Fish and Wildlife	2
Land Suitability	2
Surface Water	1
Vegetative Cover	2
Unique Natural Resource	3
Economic	
Agricultural Land	2
Commercial Forest Land	3
Rangeland	1
Social	
Recreational Resources	2
Land Managment Plans	-
Prehistoric and Historic	2
Human Population	2
Visual	
Scenic Quality	3
Visual Sensitivity	3
Legal	
Legal Constraints	-

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* - These weights reflect the Colstrip Transmission Study Team's interdisciplinary assessment of the relative importance of resources for all 15 corridor segment determinants with respect to the establishment of a corridor for two 500-kV transmission lines. The higher the number, the more important the impact.

DATA ITEMS

Each data item represents an individual resource or some facet of a resource within the study area which is likely to be influenced by electric power transmission facilities. Data items included in Step 1 analysis were limited to those resources for which data (maps) were available or could be developed in a short period of time. The Study Team also restricted the list of data items to those resources which it considered to be significant within the study area, excluding those resources which would have only a very remote chance of being impacted. Data items used for Step 1 analysis include:

LAND SUITABILITY
    Good
    Fair
    Poor

SURFACE WATER
    Sediment Risk - High
    Sediment Risk - Medium
    Sediment Risk - Low

FISH AND WILDLIFE
    High Impact Potential
    Medium Impact Potential
    Low Impact Potential
    Threatened and Endangered Animal Species

VEGETATION
    Agricultural Land
        Prime and Unique Farm Lands
        Irrigated Land
        Dry Land Farming
    Rangeland
        Good Productivity/Poor Recoverability

- Fair Productivity/Fair Recoverability
    - Poor Productivity/Good Recoverability
- Forest Land
    - Cool & Moist - Cold & Moderately Dry
    - Warm & Very Dry
    - Warm & Dry
    - Moderately Warm & Dry - Moderately Cool & Moist
    - Varied Climate
- Threatened and Endangered Plant Species
- Wetlands

SPECIALLY MANAGED AREAS

- Wilderness/Primitive
- New Wilderness Study Areas
- Roadless Areas (Includes Essentially Roadless)
- Natural Areas (Pristine, Relict, Geologic, Scenic and Landmarks)
- Game Refuges and Ranges
- State Parks and Recreation Areas
- Wild and Scenic Rivers
- Scenic Travelways
- Recreation Waterways
- Management Objectives for Specified Areas

RECREATION SUITABILITY

- High Impact Potential
- Medium Impact Potential
- Low Impact Potential

PREHISTORIC AND HISTORIC

- National Register Sites and Trails
- High Sensitivity Zone
- Medium Sensitivity Zone
- Low Sensitivity Zone

VISUAL

- Scenic Quality
  - High
  - Medium
  - Low
- Visual Sensitivity
  - Level 1
  - Level 2
  - Level 3

POPULATION DENSITY AND PROXIMITY

- 49> Persons Per Square Mile
- 5-49 Persons Per Square Mile
- <5 Persons Per Square Mile
- Population Center Crossed by or within 1 Mile of Corridor

DESCRIPTION OF DETERMINANTS AND DATA ITEMS

The following discussion deals with the data item composition and the importance weighting for each determinant. For each determinant, data items are defined, sources of information are indicated, and the development and mapping of levels of sensitivity to impact are described.

Fish and Wildlife

Definitions

Game Refuges and Ranges - These lands are controlled by the Montana Fish and Game Commission and managed for the protection of certain areas of critical game habitat. Species generally featured are elk, mule deer, grouse, pheasant, and waterfowl. Much of the land is owned by the Montana Fish and Game Department, but leased lands from Federal agencies and private landowners are included. The National Bison Range, administered by the U.S. Fish and Wildlife Service, is also included in this category.

Wildlife Impact Potentials - These are assessments of the importance of wildlife habitat (weighted by species value and the value of a habitat to a species) and the probability that significant impacts would occur.

Assumptions

Several important assumptions were made in assessing wildlife impact potentials. More detailed support for these assumptions is found in the analysis of impacts (Chapter VII).

1. The presence of a power line right-of-way on a grassland or sagebrush ecosystem would only slightly alter the pattern and distribution of potential and existing vegetation.

2. Powerline rights-of-way have a much greater impact on forested ecosystems than on grassland or sagebrush systems.

3. Certain wildlife species have specific habitat requirements of such limited distribution as to deserve special consideration.

4. Emphasis on large mammals appropriately reflects both public interest in them and their biological significance. The large mammal species are more vulnerable to habitat modification than most small animal species.

5. Access roads and construction activities have long-term impacts to the degree that such roads or activities reduce productivity through soil disturbance or provide unwanted public access.

6. Within a 2-mile wide corridor, sufficient latitude is available to avoid such specific features of habitat as elk wallows or grouse drumming grounds.

7. No adverse impacts on animals other than birds have been demonstrated for extra high-voltage structures. Birds are known to collide with the structures, but the exact significance of collision mortalities on bird populations is unknown.

8. Cool moist forest associations are important components of habitat for many wildlife species of interest, including wolverine, fisher, marten, and black-backed and northern three-toed woodpeckers.

Development and Maps

Wildlife and fisheries impact ratings were developed as a summation of game habitats, fishing streams, and cool moist forested habitats affected by corridor segments. The game habitats were weighted by resource and aesthetic value of a species and by the importance of a habitat to a species. Multiplicative values of 1, 2 or 3 for resource value, aesthetic value and habitat importance produced game species habitat importance values (Table IV-1). The two non-specific wildlife habitats (fishing streams and cool moist forested habitats) were similarly rated. The habitat importance values for each species and the two non-specific habitats were graphically summed on a mile-by-mile basis for every corridor segment. An additional multiplier of three was used for all forested habitats (including deciduous stream bottoms) to produce a total wildlife impact rating.

The total impact ratings were grouped into high, moderate and low impact potential categories to provide data comparable to those for other resource determinants. Total impact ratings greater than 80 were considered to be high; between 30 and 80 (inclusive), moderate; and below 30, low. (Forested key elk habitat has a rating of 81, non-forested key elk habitat has a rating of 27, and forested deer general winter range has a rating of 36.) These cutoff points appear to provide a reasonable distribution of high, moderate and low potential impact values for single and multiple species habitat occurrence.

Game distributions (general, winter range, and key) were used as mapped by the Montana Fish and Game Department (on file in Bozeman, Montana) with the cross-referencing of the Montana DNRC/DEIS (1974). Areas of discrepancy were resolved through professional judgment, personal knowledge of the area, and consultation with Montana Fish and Game Regional Managers. Montana fishing streams have been rated as Class I, II, III or IV by the

Table IV-1 - FISH AND WILDLIFE HABITAT IMPORTANCE VALUES

RESOURCE CATEGORY	RESOURCE 1/ VALUE x	AESTHETIC 2/ VALUE x	HABITAT 3/ IMPORTANCE =	SPECIES HABITAT IMPORTANCE VALUE
Key Wildlife Areas				
Threatened & Endangered				
Grizzly	1	3	3	9
Habitat Types				
Cool Moist Forests	3	2	3	18
Winter Areas				
General				
Elk, Moose	3	3	2	18
Mule Deer, White-tailed Deer, Pronghorn	2	3	2	12
Key				
Elk, Moose	3	3	3	27
Mule Deer, White-tailed Deer, Pronghorn	2	3	3	18
Sage and Sharp-tailed Grouse	1	3	3	9
Bio-Activity Centers				
Elk, Moose	3	3	3	27
Mule Deer, White-tailed Deer, Pronghorn	2	3	3	18
Blue Grouse	1	2	3	6
Waterfowl	2	3	3	18
Game Animals of Limited Distribution				
Elk, Moose	3	3	1	9
Bighorn Sheep, Mountain Goat	3	3	3	27
Pronghorn, White-tailed Deer	2	3	1	6
Sharp-tailed Grouse, Sage Grouse, Pheasant, Hungarian Partridge	1	2	2	4
Wild Turkey	1	3	2	6
Montana Rated Fishing Streams				
Class I & II	3	3	3	27
Class III	2	3	3	18
Class IV	1	3	3	9

1/ - Resource value is an estimate (1 - low, 2 - mod, 3 - high) of the relative economic (consumptive) value of a species.

2/ - Aesthetic value is an estimate (1 - low, 2 - mod, 3 - high) of the relative interest shown for a species (non-consumptive value). No species was rated low for aesthetic value. The combination of 1 and 2 emphasizes the importance of large mammals; an emphasis which appropriately reflects public interest. Biological rationale supporting this emphasis is found in the tendency for these species toward longer average lifespan, delayed sexual maturity, lower reproductive rates, greater absolute energy needs, larger home range requirements and smaller population which make these species more vulnerable to habitat modification than most small game or non-game species.

3/ - Habitat importance is an estimate (1 - low, 2 - mod, 3 - high) of the relative availability of a component of a species habitat. The more limited distribution and of a given component, the greater importance it assumed.

Montana Fish and Game Department. Cool moist forest habitats include ecoclasses 6, 7, and 8 (On and Losensky 1975) and were mapped by the Forest Service. General potential vegetation maps (e.g., Morris 1964) revealed only one corridor segment not mapped for habitat types by the Forest Service which might need classification as cool moist forest. Concurrence of two general vegetation maps (Morris 1964; Taylor, et al. 1975) in classifying the area as alpine or near alpine resulted in including portions of that segment in the cool moist forest habitat. Grizzly bear "critical habitat" was mapped as described in the U.S. Fish and Wildlife Service proposal (USDI 1976a). Wetlands were identified from sectional scale aeronautical charts, and 1:250,000 USGS quadrangle maps. State game ranges were identified from Montana DNRC/DEIS (1974) maps.

Composition and Value of Data Items

The wildlife determinant is comprised of wetlands, wildlife impact potentials, proposed critical grizzly bear habitat, and game refuges and ranges. Wildlife impact potentials were rated high (4), moderate (2) and low (1). Wetlands, proposed critical grizzly bear habitat, and game refuges and ranges were all rated high (4). Wetlands are uniquely productive of wildlife, including waterfowl, shorebirds and furbearers. Proposed critical grizzly bear habitat was given a high rating, a very conservative assessment of impact potential. Game refuges and ranges are rated high for their importance as wildlife habitat, and for the commitment and investments on the part of state and Federal agencies.

Determinant Value

The wildlife determinant was given an overall weighting of two (on a 1-3 scale) relative to other determinants. This reflects a moderate to high public interest in wildlife and low to moderate probability of adverse impact.

Land Suitability

Definitions

Land Suitability - the ability of the land to sustain a use (in this case, electric transmission facilities) considering the natural constraints and restrictive factors of physiography (form and arrangement of the earth's crust), geology (bedrock formation), climate (precipitation zones), soil (depth, structure, fertility, porosity, erosion potential), and vegetation (productive potential).

Good Land Suitability Rating - limitations can be overcome by normally applied practices. No special treatment is required.

Fair Land Suitability Rating - limitations can be overcome by special design, location, or practices which are available, but not normally used. Land is suitable for the use, but at additional cost.

Poor Land Suitability Rating - limitations are difficult and/or costly to overcome. Either technology is not available, or it is extremely costly to apply. The land may be allocated to the use, but an environmental cost is unavoidable.

Development and Maps

Land suitability ratings and definitions were taken from Land Suitability Pattern for Electric Transmission Lines (USDA Forest Service 1976a). This publication includes a 1:500,000 map of land suitability. Suitability is mapped by land mapping units called subsections, which are defined using physiographic, geologic, and climatic criteria, along with inferences from soils and vegetation.

Mapped subsections were assigned "good", "fair", or "poor" ratings according to their ability to sustain electric transmission facilities. The following geomorphic properties were considered in assigning these ratings:

1. flooding hazard and presence of high water table;
2. trafficability (potential for frost heaving or dust hazard);
3. bearing capacity when wet;
4. mass failure hazard (landslides or slumping);
5. slope steepness (steep slopes make construction more difficult and expensive);
6. presence of rock outcrops (rock outcrops also make construction more difficult and expensive);
7. erosion and sediment risk; and
8. presence of hard massive rock at shallow depths (contributes to construction difficulty and expense).

A "poor" rating was assigned to all subsections which exhibited the following limitations or combination of limitations:

1. severe mass failure hazard;
2. steep slopes with severe erosion and sediment hazards; and
3. steep slopes with shallow hard rock which would make construction extremely difficult.

"Fair" or "good" ratings were assigned to all other subsections. These ratings were assigned on the basis of the difficulty in overcoming the limitations.

The Land Suitability map (see Figure III-6) does not cover the portion of the study area between Colstrip and Broadview. However, by using maps of topography, precipitation, and soils, suitability ratings were assigned to these segments, based on the above approach.

Composition and Value of Data Items

The only data item used in the Land Suitability determinant was "Land Suitability". The overall suitability ratings accompanying the suitability map were based on the most pertinent properties of soil and topography (erosion hazard, depth to water table, slope steepness, mass failure hazard, etc.), and it was therefore determined that the suitability map would adequately satisfy the need for soils and topographic information.

The map and the interpretations assigned to each mapping unit provided a rating of good, fair, or poor for electric transmission line suitability. In developing the Land Suitability determinant, the mapping units which had been assigned a poor rating were given a high value (number analog of 4) and were, therefore, considered to be the least desirable for use. The rationale was that areas given a poor rating would suffer the most severe impacts, and these impacts would be the most difficult and costly (if not impossible) to overcome. Mapping units which had been assigned a fair rating were given a medium value (number analog of 2). Mapping units which had been assigned a good rating were given a low value (number analog of 1) and were, therefore, considered preferable. The impacts on these areas would be the least severe and the easiest and least costly to overcome.

Determinant Value

The Land Suitability determinant was assigned a value of 2 on a scale of 1 to 3. This reflects the fact that soils within the right-of-way would be disturbed during construction, but the disturbance would not be permanent or of extreme magnitude. Thus, its importance is considered to be only moderate.

Surface Water

Definitions

Sediment Risk - an evaluation of the probability that soil eroded from areas disturbed by construction activities would enter surface drainage channels.

High Sediment Risk - the hazard (as above) is difficult and costly to overcome.

Medium Sediment Risk - the hazard may be overcome by special measures which are commonly available and economically practical to apply, but which increase the cost of building the transmission lines.

Low Sediment Risk - the hazard may be overcome by normally used practices. No special treatment is required.

Development and Maps

The determination of sediment risk was taken directly from Land Suitability Pattern for Electric Transmission Lines (USDA Forest Service 1976a), including the 1:500,000 Land Suitability map. Each mapped subsection was evaluated individually for the probability of sediment being produced in its surface drainage channels. The primary considerations were soil erosion hazard, stream channel density, and slope. On the suitability map, each subsection is rated severe, moderate, or low for sediment risk. These terms have been changed to high, medium, and low, respectively, in this report.

Composition and Value of Data Items

The "Sediment Risk" and "Wetlands" data items were used to develop the Surface Water determinant. Sediment risk was used because an increase in sediment during construction would be by far the most significant impact on surface water systems. Wetlands were included in order to give proper consideration to their unique natural and beneficial values as directed by Executive Order 11990 (May 24, 1977).

All wetlands and all areas with a high sediment risk were given a high value (number analog of 4). These areas were, therefore, considered to be the least desirable for use. The rationale was that wetlands and high sediment risk areas would suffer the most severe impacts, and in many cases these impacts would be nearly impossible to overcome with mitigating measures. Areas with a medium sediment risk were given a medium value (number analog of 2). Areas with a low sediment risk were given a low value (number analog of 1), and they, therefore, were given priority for use in regard to the surface water determinant. The areas with a low sediment risk would suffer the least severe impacts, and the impacts would be easiest and least costly to overcome.

Table IV-6 lists the number of streams crossed by each corridor segment. This information was not used as a separate data item because it is a measure of stream channel density, which was an integral part of the sediment risk data item. Since stream channel density had already been considered, its inclusion as a separate data item could not be justified.

Determinant Value

The Surface Water determinant was assigned an importance value of 1 on a scale of 1 to 3. This reflects the fact that the primary impact on surface water (increase in sediment) would be short-term (during the construction period), and also that, in most cases, the transmission lines could span streams without disturbing the stream ecosystem.

Vegetative Cover

Definitions

Agricultural Lands - as a data item under the Vegetative Cover determinant, are grouped together regardless of crop type or management practice. Both irrigated and non-irrigated (dryland) lands are included in this category. Rangelands are not included because they are considered as a separate resource.

The agricultural lands category includes all lands currently being used for commercial production of annual crops and hay. Such lands are tilled annually or in a rotation scheme (see Figure III-14).

Rangelands - as a data item under the Vegetative Cover determinant, are grouped together regardless of their type or management (see Figure III-8). All lands on which the native vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs or shrubs suitable for grazing or browsing use are included. This resource is discussed in more detail under "Rangeland" in this chapter.

Forest Lands - as a data item under the Vegetative Cover determinant, are grouped together regardless of their type or management. This category includes all land which: (a) has at least 10 percent of its surface stocked by trees of any size; (b) is capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; or (c) has had the trees as described above removed to less than 10 percent stocking, and which has not been developed for another use. This resource is discussed in greater detail under "Commercial Forest Land" in this chapter.

Development and Maps

A composite Vegetative Cover map is an overlay of the agricultural land, rangeland, and forest land information (see Figure IV-5). Development of this information is detailed under these respective resource categories later in this chapter.

Composition and Value of Data Items

The Vegetative Cover determinant is composed of five data items: wetlands, agricultural lands, rangelands, forest lands, and threatened and endangered plant species. Wetlands were included in this determinant for two reasons. First, true wetlands have a vegetative composition unlike the other three data items and, therefore, should be considered as a separate entity. Wetlands were also included in order to give proper consideration to their unique natural and beneficial values as directed by Executive

Order 11990 (May 24, 1977). All wetlands were assigned a high sensitivity value (4) in developing the Vegetative Cover determinant.

Threatened and endangered plant species were also rated high (4) in the Vegetative Cover determinant, but as no threatened or endangered plants have been as yet officially recognized, and as no plants tentatively listed by the Smithsonian Institution (1975) or the USDI (1977) are known to exist along the proposed or alternative corridors, this data item was not utilized in the determinant evaluation.

The remaining three data items were ranked relatively, according to the ecosystem stabilizing influence of each. Forest land, regardless of forest type, was considered to be highly sensitive to transmission line impact and was assigned a value of 4. This rating was considered necessary in light of the stability that forest cover provides. To a high degree, forests are limited to mountainous and hilly terrain, where the preponderance of steep slopes, thin soils, and high precipitation zones occur. Since trees are the major factor maintaining the ecosystems of these areas, removing this vegetation to provide a power line right-of-way could have significant consequences.

Rangelands were given a medium rating (2), as they provide less ecosystem stability than forests, but more than agriculture lands (rated 1), which undergo major disruptions and cover type changes, often on an annual basis. Rangeland stability is influenced primarily by precipitation patterns and livestock management practices. In areas of high rainfall and under proper livestock grazing plans, soil erosion is minimal. Because of the continual vegetative cover and topsoil disturbance, even under the best agricultural practices there are greater amounts of topsoil losses than from the other vegetative types.

Determinant Value

The Vegetative Cover determinant was assigned a value of 2 (moderate importance of potential impact). In relation to impacts on other resources within the study area, the potential disturbance of the vegetation from introducing a power corridor would not be the most important impact, but of sufficient importance to be ranked intermediately.

Unique Natural Resources

Definitions

Wilderness/Primitive Areas - Wilderness areas are formally classified by an Act of Congress under the provisions of the Wilderness Act of 1964 (PL 8857). Primitive areas were administratively designated by either the Secretary of the Interior or the Secretary of Agriculture prior to the passage of the Wilderness Act.

Wilderness, in contrast to those areas where man and his works dominate the landscape, is defined as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. Wilderness is further defined in this Act to mean an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practical its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

New Wilderness Study Areas - Areas that have been designated by Congress for wilderness study, wilderness proposals endorsed by the Administration and pending before Congress or areas designated by the agency for wilderness study. A new study area is removed from standard management and planning considerations until its status as a wilderness area is determined.

Roadless Areas - Areas of undeveloped Federal land within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use. Narrow projecting tentacles or fingers of roadless land are generally excluded from the classification.

The second Roadless Area Review and Evaluation (RARE II) is a nationwide review of all uncommitted roadless and undeveloped Federal lands to determine their suitability for inclusion in the National Wilderness Preservation System or for other possible uses. The inventoried RARE II lands will be placed into three separate categories:

(1) those to be recommended for immediate addition to the National Wilderness Preservation System;

(2) those which will undergo further study to determine whether or not they should be included in the wilderness system; and

(3) those which would be managed for resource values other than wilderness.

These recommendations will be sent to the Secretary of Agriculture for further review and administrative or legislative action.

Natural Areas - A physical and biological unit in as near a natural condition as possible which exemplifies typical or unique vegetation and associated biotic, soil, geologic and aquatic features. The unit is maintained in a natural condition by allowing physical and biological processes to operate, usually without direct human intervention.

State Parks and Recreation Areas - Areas that are officially designated and recognized in the Montana Statewide Outdoor Recreation Plan (4th Edition), prepared by the Montana State Fish and Game Commission, March 1, 1973.

Wild and Scenic Rivers - The Wild and Scenic River Act, as amended through P.L. 94-486, declares that it is the policy of the United States that certain selected rivers of the nation, which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The act provides for three classifications:

(1) wild river areas - Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America;

(2) scenic river areas - Rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads; and

(3) recreational river areas - Rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Wetlands - Areas of extensive aquatic, emergent and riparian vegetation periodically or permanently flooded with shallow water.

Threatened and Endangered Species (plants) - None have been officially recognized or known to exist along the corridors within the study area.

Development and Maps

A transmission line crossing any of these data item areas would create an impact not only on the resources of the area, but also on its management. Management plans would have to accommodate this type of use or undergo significant changes in philosophy and objectives. In the case of wilderness areas, political action would be needed to declassify the transmission line corridor. The impact potential on management would have to be explored in detail to resolve of any conflict; for the purposes of this report, only the highlights are presented (Chapter III).

The many sources used to map these items were provided by Federal or state agencies. Data were gathered from the U.S. Forest Service, Soil Conservation Service, Bureau of Land Management, Bureau of Outdoor Recreation, Montana Department of State Lands, Montana Department of

Fish and Game, and the Montana Department of Natural Resources and Conservation.

Composition and Value of Data Items

This determinant is composed of certain data items that are in their natural state or have been only minimally impacted by man's activities. The exception to this is plant communities that have been influenced by fire suppression. The data items are: wetlands, threatened and endangered plant species, wilderness/primitive areas, new wilderness study areas, roadless areas, natural areas, state and county parks, and wild and scenic rivers.

The unique plant communities located in wetlands, threatened and endangered plant sites, and natural areas have a high (4) potential for impact from transmission line construction because of their small size and very limited distribution. Maintenance of these areas is of national or state significance in preserving natural ecosystems.

Wilderness/primitive areas, new wilderness study areas, and wild and scenic rivers also have a high (4) impact potential. The introduction of a transmission line through one of these areas would depreciate the size and/or the intrinsic values that helped to establish recognition of the area.

State and county parks are given a medium (2) impact potential rating. The parks are generally located around and managed for signficant natural features such as waterfalls, caverns, or old-growth trees. The areas have a lower impact potential than those noted above because some modification of the environment has already been made to accommodate visitors. Camping, picnicking, access, parking, and various shelter facilities are generally in close proximity to the natural feature(s) and so the naturalness of the area has already been compromised to some degree.

Roadless areas are on a lower level of protection than classified areas and parks, and of a lower value for protection than areas containing threatened and endangered plants or pristine and unique vegetative communities. For these reasons roadless areas are given the lowest (1) impact potential rating. Roadless areas also contain many man-made intrusions such as primitive roads, mining, and prospecting pits, and old structures.

Determinant Value

The value for this determinant is high (3). This rating reflects both the overall public regard for these items and the high impact potential that transmission line construction and maintenance would disturb or eliminate areas containing significant natural vegetative communities. It is believed that once some of these natural communities are disrupted, they cannot be reproduced.

Agricultural Land

Much of the surface vegetation of Montana is represented by agricultural crops. As such, the vegetation varies from one year to another, and even from month to month. On non-irrigated agricultural lands, fields are often left idle during alternate years (or in some rotation pattern) as summer fallow. During this time, there will be no growing vegetation on that field so, in certain cases, the land may be essentially bare for 20-21 months out of a 2-year rotation period. Under irrigation, crops are usually grown each year or a perennial forage crop is produced. The main crops grown under non-irrigated conditions in Montana are winter wheat, spring wheat, barley, and oats. Irrigated lands are used mostly to produce potatoes, sugar beets, corn, dry beans and forages. A few specialty crops grown under both irrigated and non-irrigated conditions include mustard, safflower and grass and forage seed crops.

Definitions

Prime and Unique Agricultural Lands - are agricultural lands which are uniquely suited to specific agricultural production pursuits, or which are classed as "prime" lands by state of Federal agencies. An example of unique farmland is that land surrounding parts of Flathead Lake which is uniquely suited for cherry orchards as a result of the ameliorating effect of the lake on local climate and the deep, coarse-textured soils. According to Federal standards, prime and unique farmlands are described in Soil Conservation Service (SCS) "Land Inventory and Monitoring" memo 3, revision 1, August 16, 1977. These lands have not been mapped in Montana.

Irrigated Lands - are those which receive supplemental water applications on a more or less regular basis, and which also are identified as agricultural lands as previously defined in the "Vegetative Cover" section of this chapter.

No breakdown is made based on type of water application system. These range from surface flood irrigation to wheel-roll, big-gun, and center-pivot systems.

Non-irrigated Lands - must rely on precipitation to supply water for crop growth. These non-irrigated lands include large acreages of summer fallow, a system under which crops are grown on an alternate year schedule, by which the soil is tilled for weed control and water storage during the fallow period.

Development and Maps

Recent land-use maps which show the location of cultivated agricultural lands are available for only a few counties of Montana. Within the study area, such maps are available for Rosebud and Treasure Counties through a recent "Section 208" water quality management plan and study conducted by the Yellowstone-Tongue Areawide Planning Organization. Similar maps for Big Horn, Yellowstone, Stillwater and Sweetgrass Counties were developed at a scale of 1:250,000 by the Mid-Yellowstone Areawide Planning Organization. However, lack of mapping control makes them of little value for identifying exact locations of agricultural lands in relation to specific corridor segments.

Land-use maps for Lake County which were published in the January, 1977, "Report of the '208' Study for Flathead Drainage", are too small and generalized to be of value except to indicate large agricultural areas within the county.

A detailed agricultural land-use map for the area of southeastern Montana underlaid by strippable coal is available from the Department of Natural Resources and Conservation in Helena. Agricultural lands (as of 1974) crossed by corridor segments in Rosebud, Treasure and Big Horn Counties are identifiable on this map.

To develop a map of all agricultural lands of the study area, satellite imagery prints were used. These prints (false-color imagery composites of bands 4, 5 and 7, ERTS Satellite, 1:500,000 scale) show quite clearly land surfaces that have been disturbed by tilling. Also, various crops show color "signatures" which are distinct from range or forest land. Images taken during 1976 summer months were obtained through cooperation of the USDA-LACIE coordinator in Houston, Texas. The LACIE (Large Area Crop Inventory Experiment) program is designed to identify agricultural crops from satellite imagery. The prints obtained were selected for their clarity and detail in showing cropped areas. Also, the recent information from these images was used to update some of the older information sources.

A composite map of the entire study area was made from nine different false-color ERTS prints. The linear geometric configurations and color differences of agricultural areas could be quite readily identified and traced onto a mylar overlay. Water bodies (lakes and streams) were used as mapping control points. To supplement this data source, a composite map of irrigated lands of the study area was made from An Atlas of Water Resources in Montana by Hydrologic Basin, Inventory Series Report No. 11 of the Montana Water Resources Board in Helena. This atlas shows all irrigated agricultural lands, many of which are too small and isolated to be readily discernible on satellite imagery. Accuracy of the map derived from combination of these two data sources was verified by comparison with the recent land-use maps developed by "208" projects mentioned earlier. Also, this map was checked by flying all corridors, revealing that only a few small, irregularly shaped fields in rough, broken lands had not been identified (see Figure III-14).

A corridor segment overlay map, superimposed on this map of agricultural land, allowed for measurement of the distance each segment crosses these lands.

Composition and Value of Data Items

The agricultural lands determinant is composed of three data items: prime and unique lands; irrigated croplands; and non-irrigated croplands.

A number of areas of agricultural land may be considered "prime" land due to inflated real estate values, but this value usually reflects factors other than agricultural production capacity. Factors which increase values of such lands are considered in other categories, and thus enter into the evaluation of corridor segments in that way. Prime or unique agricultural lands would be afforded a high impact rating (4) if they were found to be crossed by a segment. However, none were identified within the study area.

Within the Agricultural Land determinant, irrigated lands would have a potentially high impact from a power line. The two major reasons for this are: (1) irrigated lands usually produce greatest yields and highest values of crop production, and areas removed from further production would result in relatively large economic losses per unit area and (2) irrigation systems (with the exception of flood irrigation) involve the use of equipment which often requires large spaces for unimpeded movement (e.g., wheel-roll and center-pivot systems). Power line structures may interfere with locating and operating such systems. For these reasons, irrigated land was given a high (4) impact rating .

The main impact of a power line crossing non-irrigated agricultural lands is the difficulty of maneuvering large tillage, seeding and harvesting equipment around the power structures or guy wires. There also is some impact on total production since some area is removed from crop production. Non-irrigated land was considered to have a moderate (2) impact rating.

Determinant Value

The Agricultural Land determinant consists of a combination of irrigated lands and non-irrigated land (since no prime and unique lands have been identified). If this determinant were considered as a unit in the economic environment, the impact of a power corridor would be moderate (2). The amount of acreage taken out of production would be quite small (except during the construction phase), and increased farm management costs would not be great. Comparatively, this degree of impact would be intermediate or "moderate" in importance.

Commercial Forest Land

Definitions

Forest Land - Land which: (a) has at least 10 percent of its surface stocked by trees of any size; and (b) is capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; or (c) has had the trees as described above removed to less than 10 percent stocking, and which has not been developed for another use.

Forest Type - A category of forest land defined by its vegetation, particularly by its composition. The type is usually named for the species that dominates by numbers (seedlings and saplings) or by volume (poles and sawtimber). In Step 1, the types are named by the general temperature and moisture characteristics that predominate for the various forested lands.

Site Index - A particular measure of forest productivity based on the average height of the dominant and codominant trees in a stand at an arbitrarily chosen age. In this report, the site index is given for a 50-year base period.

Commercial Forest Land - Forest land which is (a) producing, or physically capable of producing, usable crops of wood (usually sawtimber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

Tree Size - Tree size is generally categorized into the following three groups, based on diameter breast high (dbh):

a. Sawtimber - Trees having dbh of 9 or more inches.
b. Poles - Trees with dbh of 5-9 inches.
c. Seedlings and Saplings - Trees with dbh of less than 5 inches.

Stocking - A measure of the proportion of land area actually occupied by trees, expressed in percent of canopy closure:

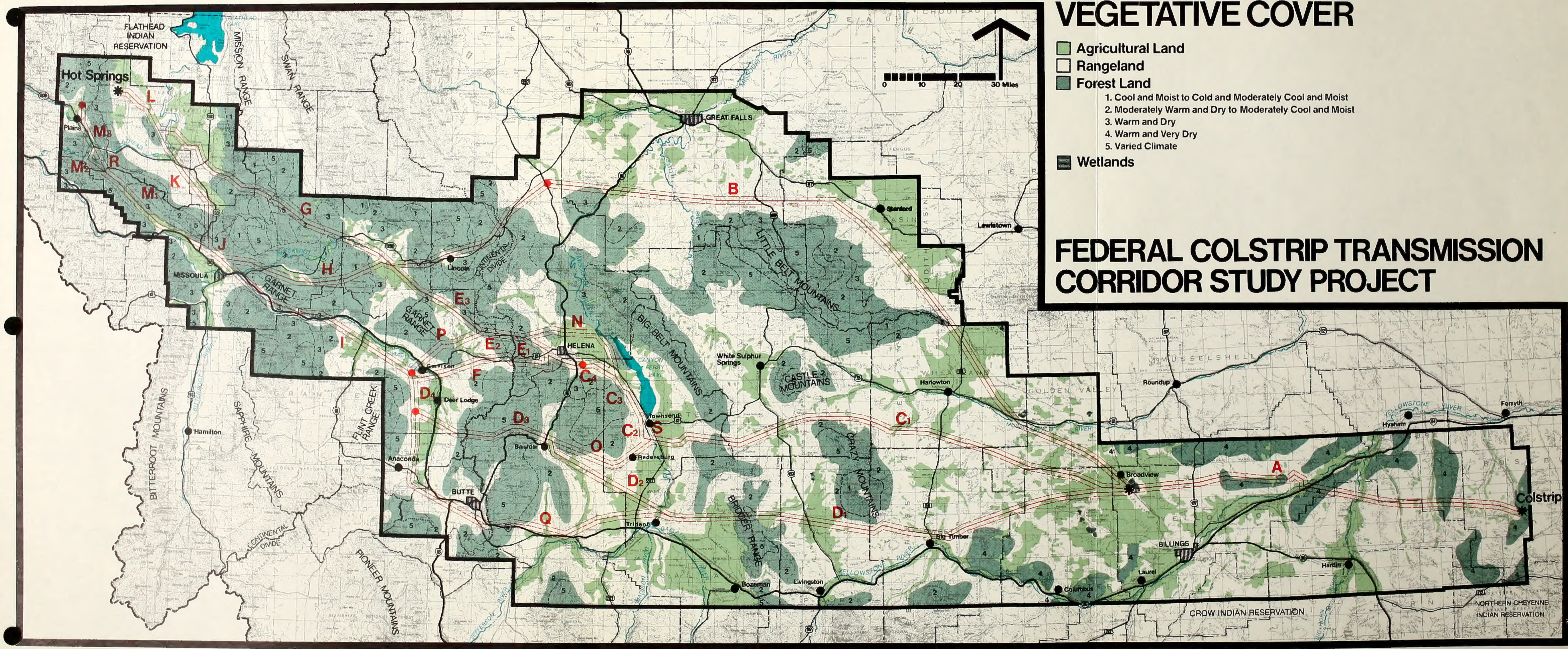
Well stocked	70-100%
Medium "	40-69%
Poorly "	10-39%

Merchantable - Trees, crops, or stands of a size, quality, and condition suitable for marketing under given economic conditions, even if so situated as not to be immediately accessible for harvest.

Development and Maps

The designation of data items for commercial forest land used in Step 1 differs from the forest types described in the Existing Environment (Chapter III). The Step 1 descriptions were readily available and there is enough diversity in productivity and management options among the types so that values may be assigned to each type for this initial phase of corridor segment analysis and evaluation (see Figure IV-5).

Cool and Moist to Cold and Moderately Dry Forest Land - This area is composed primarily of small, slow-growing conifers adapted to high elevations. This type is also common at some lower elevations (2,000 feet) in the Northern Rocky Mountains, where the trees are larger and more thrifty than at the higher elevations. Common species include subalpine fir, mountain hemlock, lodgepole pine, whitebark pine, and some Engelmann spruce. Areas above tree line are included in this type. The topograhy is moderate to very rugged mountains. Precipitation



VEGETATIVE COVER

- 🟩 Agricultural Land
- ☐ Rangeland
- 🟩 Forest Land
  1. Cool and Moist to Cold and Moderately Cool and Moist
  2. Moderately Warm and Dry to Moderately Cool and Moist
  3. Warm and Dry
  4. Warm and Very Dry
  5. Varied Climate
- ▨ Wetlands

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure IV-5

exceeds 30 inches per year. Soils are generally well drained and have a low water holding capacity. Cool to cold temperatures and short growing seasons limit the productive capacity of this type, and consequently vegetative recovery after a disturbance is slow. This type is highly sensitive to soil and vegetative disturbance. Site indexes are low, ranging from 30 to 50, but the volumes may range up to 13,400 board feet per acre on the better sites.

Moderately Warm and Dry to Moderately Cool and Moist Forest Land - This warmer forest zone is below the previously discussed zone. Douglas fir is the most common tree species, although large numbers of western larch, Engelmann spruce, grand fir, subalpine fir and lodgepole pine are present. Western red cedar and western white pine are found in the northwestern corner of the state. Ponderosa pine is common at the lower elevations of this type. The topography is moderately to steeply mountainous with deeply dissected drainages. Distribution of the type ranges from the lower slopes to the subalpine zone. Precipitation ranges from 15 to more than 30 inches annually. Soils are poorly drained and loamy to well drained and gravelly; depth to bedrock varies greatly, but is generally 20 inches or more. The favorable combinations of climate, soils and elevations give this type the highest potential for producing commercial timber crops. Vegetative recovery after a disturbance is moderate to rapid. Site indexes range from 55 (medium) to 90 (very high). The volumes run from 5,000 board feet per acre on the poorly stocked sites to over 30,000 board feet per acre on the best sites. Steep slopes that place strong constraints on management activities are common.

Warm and Dry Forest Land - This type occupies a zone on the lower slopes and in the valley bottoms of the western mountains. Pure stands of ponderosa pine are found on the south and west aspects. These are the driest sites occupied by forests. Douglas fir, western larch, and lodgepole pine are common associates on the more moist sites. The landforms include benches, wide bottoms, and steep mountain slopes on the south and west aspects. Precipitation ranges from 21 to 24 inches per year. Soils are generally well drained and often developed in recent alluvium. On the better sites, ponderosa pine has the capability of growing at exceptionally fast rates, and vegetative recovery after a disturbance is moderately fast. On the drier sites, vegetative recovery is slow. Site indexes are low to moderate, ranging from 30 to 70. The volumes are equally as variable, ranging from 1,100 to 15,500 board feet per acre. This type has been important historically in providing commercial-sized timber because of the high value of ponderosa pine and the easy access.

Warm and Very Dry Forest Land - This type occurs in the eastern half of Montana. Pure or nearly pure stands of ponderosa pine are fairly common. Associated species include Douglas fir and Rocky Mountain juniper. In some areas limber pine is common. The trees in this type are generally more widely spaced than in the westside ponderosa pine type. Landforms vary among gentle to steep slopes, hilly uplands, plateaus, and outcroppings of shale or sandstone. Annual precipitation is generally in the 10 to 14 inch range. Soils may be loams, clay loams, or silt loams. The boles of the trees in this type, when compared with the western type, are short and more suppressed relative to height and diameter growth. Vegetative recovery after a disturbance may be very slow to moderate depending on the precipitation and extent of disturbance. This type has lower site indexes, lower volumes per acre, and lower lumber grade recovery than the Warm and Dry Forest Land.

Varied Climate Forest Land - Lodgepole pine is the typical tree species in this forest type. It is considered to be a distinct type when the other tree species do not exceed 20 percent of the cover. The species generally associated with lodgepole pine are subalpine fir, ponderosa pine, Douglas fir and western white pine, although several others are also found. Lodgepole pine grows especially well on gentle slopes and in basins, but good stands may be found on rough and rocky ground. Northern and eastern aspects are more favorable to the species than western or southern aspects. Best growth occurs where the annual precipitation is 21 inches or more. Soils are generally moderately well drained loams developed in granitics, shales, or sandstones. Vegetative recovery is rapid on the sites favorable for lodgepole pine, and this species is frequently the only tree to become quickly established after a fire or other large disturbance. Timber productivity is low to moderate, but the gentle topography allows for a great flexibility in management activities. Until recently, lodgepole pine was considered a weed tree, but it is now utilized for a wide range of products.

Composition and Data Item Values

This determinant considers only forest land defined as commercial forest land, including the moderately warm and dry - moderately cool and moist forest land, warm and dry forest land, warm and very dry forest land, and varied climate forest land.

Transmission line clearing would have the greatest impact, in terms of acres cleared and volume per acre removed, in areas of medium to well stocked sawtimber-sized stands. Less impact would be realized in sawtimber stands with poor to medium stocking levels, and the least impact in stands of pole-sized timber or open sawtimber stands.

To relate the forest types described under "Existing Environment" (Chapter III) to the above impact potential criteria, the following interpretations have been made. Mature trees in the moderately warm and dry to moderately cool and moist forest land type are generally in medium to well stocked stands. The warm and dry forest land type contains mature trees that are tall, of sawtimber size, but are generally in poor to medium stocked stands. Much of this type has also been cut over and it is now supporting second-growth trees that are shorter and of smaller diameter than mature trees. In the warm and very dry forest land type mature trees are smaller in both diameter and height than trees in the moderately warm and dry - moderately cool and moist, and warm and dry forest land types, and are generally growing in more open stands. Clearing impacts would be less for this type as a result of the wider spacing of trees. Mature trees in the varied climate forest land type are generally shorter than those found in the other types and are of pole size. The shortness of the trees permits moderate to light clearing and the volumes lost per acre would be less than in other types.

Based on these interpretations, the moderately warm and dry - moderately cool and moist forest land type is considered to have a high (4) impact potential; the warm and dry forest land, a medium (2) impact potential; and the warm and very dry forest land and varied climate forest land types have low (1) impact potentials.

Determinant Value

The value for this determinant is 3 (high). This rating is based on the overall high impact potential associated with the clearing of forest lands in the right-of-way and for roads that have to deviate from the right-of-way in mountainous terrain. The duration of the impact (keeping trees cleared from around towers, in areas of low conductor sag, and on permanent roads) would be as long as the power lines exist. Timber harvest operations in areas adjacent to the right-of-way may also be influenced because of constraints placed on equipment use in the vicinity of the lines.

Rangeland

Definitions

Rangelands - are lands on which the native vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs or shrubs suitable for grazing or browsing. They include lands revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. Rangelands include natural grasslands, savannahs, shrublands, most deserts, tundra, alpine communities, coastal marshes and wet meadows (SRM 1974). As much of the forest within the study area is also grazed by livestock, forest land was also included in this analysis.

Productivity - refers to the amount of biomass produced in a given area during a given amount of time. Productivity can either be expressed as the number of pounds of forage produced per acre, or as the number of acres required to support one animal unit for one month (Acres/Animal Unit Month). An animal unit is considered to be one mature (1,000 lb.) cow and her calf under 6 months old, or the equivalent, based upon average daily forage consumption of 26 pounds dry matter per day (SRM 1974).

Acres per Animal Unit Month (a/AUM) was the unit of measurement used in this analysis.

Recoverability - In general, relative recovery relationships will remain the same whether defined in terms of aesthetics, erosion stabilization, or productivity. That is, the amount of time it takes to achieve the "recovered" level in one vegetative type relative to another vegetative type will remain essentially the same. However, in order to assign ratings, three criteria, as defined by DNRC/DEIS 1974, were used to provide a more concrete definition:

a. Life-forms - An area is not considered recovered unless indigenous late-successional life-forms dominate.

b. Erosion prevention - Soil development partially determines which plants can grow and prosper in an area. Soil evolution is a very slow process, often measured in hundreds and thousands of years. In order for an area to recover, its soil must be kept relatively intact. For this reason, prompt revegetation during the same growing season with plants that prevent accelerated erosion and invasion by undesirable plants is a necessary part of recovery.

c. Productivity and economic properties - Recovery includes establishing plant communities with productive and economic properties similar to those of pre-disturbance communities. Areas where recovery proceeds slowly due to limiting factors are more severely impacted by construction activities than are sites that recover more quickly.

Development and Maps

The map titled Potential Vegetative Rangeland Types was used for the rangeland analysis in Step 1 (Figure III-8). This map was originally developed in the early 1940's by an Inter-agency Range Committee composed of Federal and state agencies. This committee produced a vegetational type map of Montana with type descriptions. The map was updated in 1973 by the Department of Animal and Range Sciences, Montana Agricultural Experiment Station, Bozeman, Montana.

The base data used in the preparation of this map were derived, primarily, from range surveys and range reconnaissance studies, and soil surveys and soil reconnaissance studies of the member agencies. These data were supplemented by committee members and range technicians with personal knowledge of the state (MSU 1973).

This map classifies vegetation into broad vegetative types. The type boundary delineations were based on potential or climax communities that would be found in the area if it had not been for the past major disturbances by man.

The fact that vegetative types based on climax associations were used in this analysis does not imply that all, or even most of, the study area is in a state of climax or that climax communities are necessarily the most desirable from a range management standpoint. Rather, vegetative typing based on the potential for any given area allows the recognition of inherently similar areas despite the camouflaging effects of disturbance.

Further, potential productivity rather than existing productivity was used as one of the parameters in the Step 1 analysis because power transmission lines require long-term commitment of land; therefore, using existing productivity could result in short-sighted impact allocation. Also, existing productivity cannot be accurately predicted by vegetative typing because of variable history and stand development. However, it is expected that comparative productivity rankings, whether potential or existing, would be the same, although the values for potential and existing productivity would differ.

Productivity - The delineation of rangeland vegetative types within the study area, and potential productivity for each type, expressed as a/AUM, were taken from Bulletin 671, Vegetative Rangeland Types in Montana, Montana Agricultural Experiment Station, Montana State University, Bozeman (1973). The a/AUM values for each vegetative type are listed in Table IV-2.

Table IV-2 - IMPACT RATINGS FOR POTENTIAL VEGETATION PRODUCTIVITY/RECOVERABILITY

VEGETATIVE TYPES	POTENTIAL a/AUM	PRODUCTIVITY	RECOVERABILITY	IMPACT RATING
Sub-alpine Forest	4.0	2	5	H
Larch-Douglas Fir Forest	23.5	1	4	L
Lodgepole Pine-Douglas Fir Forest	7.0	2	3	L
Western Montana Ponderosa Pine Forest	3.5	3	5	H
Intermountain Valley Grassland & Meadow	1.5	5	1	L
Foothill Sagebrush	3.5	3	3	M
Foothill Grassland	2.5	4	1	L
Northern Grassland	3.5	3	2	L
Teton River-Judith Basin Grassland	2.5	4	2	M
Central Grassland	3.0	3	2	L
Eastern Montana Ponderosa Pine Forest	3.0	3	5	H
Beartooth Juniper-Limber Pine Forest	10.0	1	5	M
Ponderosa Pine Savannah	3.0	3	3	M
Riparian	2.0	5	1	L
Sandy Grasslands	2.5	4	2	M

* - The higher the productivity and recoverability rating, the greater the potential impact.

In calculating the range productivity potential, it was assumed that forests will remain as forests, and will not be managed as rangelands. To do otherwise would invalidate the forest productivity ratings, since a site cannot normally be managed to simultaneously maximize both timber and grass production. Using the criteria established by the Montana's Department of Natural Resources and Conservation (DNRC) for the Clyde Park-Dillon Transmission Line EIS, the most productive forest vegetative types are equivalent to the least productive grassland types with respect to range productivity. Forest types were rated as 1, 2, or 3, while grassland types were rated as 3, 4, or 5 (Table IV-2). A high rating refers to a highly productive vegetative type, therefore a high impact potential exists.

Recoverability - The recoverability criteria also follow those established by the DNRC for the Clyde Park-Dillon Transmission Line EIS. The consultant's report for the Colstrip to Hot Springs, Montana Transmission Line, Westinghouse Project ESD-090-73, by George B. Chaffee (1973), was also utilized to assign the recoverability values.

Forest vegetative types as a group were rated slower in recovery than grassland vegetative types and assigned either a 5, 4, or 3, for, in a sense, forest types never recover as long as a transmission line exists. This rating is justified in terms of the definition of recovery stated previously:

a. Life-form - the dominant late successional life form (trees) is not allowed to dominate.

b. Erosion Prevention - forests are generally most effective in reducing erosion but they are not usually allowed in utility corridors.

c. Productivity and Economic Properties - when forest habitat types are managed to favor understory species, a negative long-term impact on the timber industry can be expected. Ranchers may benefit in the short run, depending on the palatability of the species re-occupying the site and accessibility to livestock, but overall site productivity would undoubtedly be lower if trees were excluded.

Two principal factors limit the rate of recovery in grasslands and shrublands: (1) available moisture; and (2) grazing (Dyksterhuis 1951). Grazing intensity is the perogative of the landowner; therefore, it is unpredictable and cannot be entered into any calculations. Moisture, then, is the primary analyzable determinant of recovery rate. Moisture is also the main limiting factor for productivity, so alignment of grassland vegetative types along a moisture gradient similar to the one used in determining potential productivity was used in rating grassland recovery rate.

Generally speaking, rangelands in good condition respond more rapidly to disturbances, recovering faster than ranges in poor condition. Therefore, general range condition was taken into consideration in recovery rate determinations.

Power transmission lines constructed in grassland vegetative types, as opposed to forest rangeland types, allow all three criteria of recovery to be met. Thus no overlaps of recovery rate with forest vegetative types were allowed. Therefore, grasslands were assigned a value of either 1 or 2. According to the State's EIS (DNRC/DEIS 1974), blue grama is present only on the warmest and dryest sites, so the four vegetative types containing appreciable amounts of blue grama were rated 2 with respect to recovery and the other three grassland types were rated 1. The sagebrush vegetative type was considered slightly slower in recovery than the grassland types and rated as 3 (note Table IV-2).

Composition and Value of Data Items

The "Rangeland" determinant is composed of three data items. These are good productivity/poor recoverability, fair productivity/fair recoverability, and poor productivity/good recoverability, and were assigned high, medium and low values respectively (see Figure IV-4). These data item terms were used in lieu of listing the 15 vegetative types in the Step 1 Matrix (Figure IV-4), as doing so would have made the matrix somewhat unwieldy as a working tool.

Two properties that seem best suited to comparatively assess the values of rangeland vegetation are potential range productivity and recovery rate. In assigning impact ratings to the vegetative types, few types fit neatly into one of the three data items. Therefore, it became necessary to subjectively analyze each vegetative type not only for range productivity and recoverability potential, but also based on the precipitation zone each vegetative type was most commonly found in and the relative extent of each vegetative type in the study area.

The recoverability factor was emphasized slightly more than the productivity factor because recoverability potential essentially determines impact duration (i.e., short-term or long-term). For example, the subalpine forest type has fairly low potential productivity, but being assigned the highest potential recoverability impact rating (meaning slowest to recover), and also being very limited in distribution, it was assigned a high impact rating (see Table IV-2).

The larch-douglas fir type is also quite slow to recover (rated 4, with 5 considered slowest), but because its potential range productivity is extremely poor (rated 1), it received a low impact rating. The beartooth juniper-limber pine type is the only other type that received a potential range productivity rating of 1, but because this type was also given the worst recovery rating, and, because -- as mentioned previously -- recoverability was given slightly more emphasis than productivity, its impact rating was elevated to "moderate."

The riparian vegetative type had both the highest productivity rating (5), and the fastest recoverability rating (1). Where transmission lines span rivers and streams, towers are normally placed a sufficient distance back from the stream banks so that direct impacts on riparian vegetation would be minimal and short-term. The impact rating for this vegetative type was, therefore, low. The other vegetative types were analyzed in a similar manner and assigned potential impact ratings, as shown in Table IV-2.

It must be emphasized that these impact ratings are based on potential impacts on rangeland only. In other words, in developing the rangeland resource data associated potential impacts on other resources were not considered. To include these would have overemphasized resources such as wildlife or aesthetics, which were already being analyzed as separate determinants.

Determinant Value

The Rangeland determinant was assigned a relative value of 1 (lowest impact potential). The open rangeland resource would be much less susceptible to impacts from the introduction of transmission facilities than would other land types where the alternative locations are forested land, agricultural land or residential areas.

The greatest impact on rangelands from the introduction of a transmission line would be removal of vegetation, which would have a direct effect on the livestock industry by reducing the number of acres of available forage. The quantity of forage lost due to the construction of towers and maintenance roads would probably not be significant enough to require reductions in livestock use, or to cause any other major operational changes on ranches located along the corridors.

Recreation Resources

Like recreationists throughout the rest of the United States, Montana residents spend most of their recreating time driving for pleasure, sightseeing, and walking for pleasure. In spite of the energy problem in this country, 1977 was Montana's biggest travel year and it is likely that 1978 will be bigger (Gilluly 1977). Because of its relatively undeveloped character, most of Montana's land is valuable for some form of recreation use, particularly for those dispersed recreation activities that need a lot of open space.

Definitions

The following recreation suitability criteria were developed to measure the recreation resources values of each acre of land influenced by the transmission corridor under study:

High

a. Lands near major, high quality streams, rivers, lakes, and reservoirs that have national, regional and state importance.

b. Lands near existing recreation sites identified in the 1973 Montana State Outdoor Recreation Plan (includes National Register Sites, historic sites, archeological sites, etc.).

c. Lands near Class I, Class II and Class III fishing streams (Montana Fish and Game Department rating system).

d. Good accessibility (paved highways and maintained gravel roads).

e. Lands with conifer vegetation since research shows high user preference for these areas (USDA Forest Service 1974c).

f. Gentle topography (0-20% slope).

g. Close proximity (1 to 1.5 hour drive) to urban areas (10,000+ population). Bureau of Outdoor Recreation criteria shows a high value for recreation areas within a 1 to 1.5 hour drive of urban areas (USDI 1973).

h. Land ownership primarily public. For this study public lands were regarded as more accessible than private lands.

i. Absence of conflicting land uses (such as railroads, utility lines, industrial sites, and mining operations).

j. Lands with high scenic values (high level of vegetative and landform variety.

Medium

a. Lands near streams, rivers, lakes and reservoirs that have only local significance (smaller, less attractive water bodies).

b. Lands near Class IV and medium quality non-rated fishing and recreation waters.

c. Conflicting land uses present such as railroads, utility lines, industry and mining operations.

d. Lands over a 1.5 hour drive from major urban centers but still relatively close to smaller communities (10,000 or less population).

e. Fair accessibility.

f. Gentle to moderately steep topography (10-30% slope).

g. Land ownership approximately 50% public and 50% private.

h. Moderate landform and vegetative variety.

Low

a. Lands removed from important water-oriented recreation opportunities. Water features limited to intermittent drainages.

b. Steeper lands with slope over 30%.

c. Minimal landform and vegetative variety.

d. Areas remote from population centers.

e. Road access either very limited or completely absent.

f. Very significant number of conflicting land uses present (railroad, industry, mining, etc.).

g. Public ownership either very sparse or "landlocked"; private ownership predominates.

Development and Maps

The Study Team, using the above criteria, mapped the areas crossed by the Applicant's corridor and the Step 1 alternatives at a scale of 1:250,000 and rated them as having high, medium or low resource importance.

Composition and Value of Data Items

The Recreation Resource determinant for Step 1 consists of the recreation suitability data item. High recreation suitability values were rated as having a high (4) impact sensitivity, medium recreation suitability values were rated as having a moderate (2) impact sensitivity; low recreation suitability values were rated as having a low (1) sensitivity to impacts.

Determinant Value

The Recreation Resource determinant was given an overall importance weight of 2 (on a scale of 1 to 3) when compared to other resources. Recreation values are also inherent in the two visual impact determinants which were considered separately.

Land Management Plans

Definitions

Management Objectives for Specified Areas - National Forest land has been subdivided into various-sized geographic areas called planning units. These units are generally characterized by particular patterns of topography, climate, and land use. The function of unit planning is to update the multiple use plans on the National Forest lands. The proposed land management plan for the planning unit must be published in a Draft Environmental Statement for public and agency review and comment, and the selected management plan is then published in a Final Environmental Statement.

Definitions for the other data items are found under Fish and Wildlife, Unique Natural Resources, and Visual and Recreation Resources sections of this chapter.

Development and Maps

Each of the data items comprising this determinant have management plans that are in existence or under preparation. The introduction of a power transmission line through any of these areas would have some impact on the management or the management objectives for the area. It is this impact that is being evaluated.

Composition and Value of Data Items

This determinant includes all of the data items identified under Specially Managed Areas. These are: wilderness/primitive areas, new wilderness study areas, roadless areas, game refuges and ranges, state and county parks, wild and scenic rivers, scenic travelways, recreation waterways, and management objectives for specified areas.

A high value was assigned to all data items because of the uniqueness of an area, the legislative support that an area carries, or because an area has specific management objectives that must be recognized.

Determinant Value

A numeric value is not assigned to the data items or to the determinant. If the transmission corridor crosses a data item area, the conflict is noted and the seriousness of the conflict is specified.

An "X" indicates data item areas partially overlapped by a corridor where the centerline could be located within the corridor to avoid the area. The number symbol (#) indicates an area of serious conflict which could be avoided only by relocating the corridor. A "C" indicates that the transmission corridor location is in conflict with the goals or objectives of a land management plan.

Prehistoric and Historic

Definitions

Prehistoric - includes three periods as defined by Mulloy (1958). The Early Prehistoric Period is from approximately 10,000 to 15,000 years ago to approximately 6,000 years ago. The Middle Prehistoric Period began approximately 5,000 to 6,000 years ago, after a postulated cultural hiatus of approximately 2,000 years duration. The late Prehistoric Period began approximately A.D. 450 and lasted until the beginning of the 19th century.

Historic - begins approximately with the 19th Century and runs to the present.

Sensitivity - relates to the degree of potential impact on a prehistoric/historic site or other aspect of this resource, and the degree to which this impact could be mitigated without destroying the value of the resource, per the National Historic Preservation Act of 1966 and 36 CFR 800 procedures.

Development and Maps

The available state and local prehistoric and historic information was taken from State of Montana computer printouts of July 25, 1975. It must be emphasized that relying only on known resource data is inadequate for a realistic assessment of potential impact on the prehistoric and historic resource, because the data has been collected in sporadic, spotty, and uncoordinated research efforts. However, the Study Team felt that inclusion of the data was an important aspect of the analysis, and had to be addressed.

For the purpose of evaluating segments, each site within two miles of either side of the segment's centerline was plotted on a map. The total number of sites in each township crossed by a segment was also recorded, even if the sites were outside the two mile limit. This second inventory was considered, for the purposes of this study, to be a reflection of site density.

In Step 1, the following attempt was made to account for the unknown (undiscovered) sites. A low sensitivity value was assigned for each mile of segment length that did not contain a known site within two miles to either side of its centerline. This simply accounts arithmetically for the possibility of more sites being near a long segment than near a shorter one. A density factor, which is the total number of sites located for all the townships crossed by the segment, was also added to each segment. Thus, situations where there are no known sites within two miles of either side of a segment, but many sites within the townships crossed by the segment, would be reflected in this density factor.

Composition and Value of Data Items

It is recognized that all prehistoric and historic sites are essentially of equal and high value. However, a stratification of sites into high, medium, and low sensitivity groups was made to reflect different impact potentials related to the various sites.

Resource data items (sites) were divided into these three sensitivity groups by making an assumption about their potential for being impacted. Site types most difficult to salvage without loss of value were placed in the highest sensitivity category. For the purpose of evaluating segments, each site located within two miles of the segment centerline was considered the equivalent of one mile of sensitivity length. To incorporate the density factor, townships with five or more sites were considered to have high sensitivity; one to four sites, medium; and no sites, low.

The following stratification and data item value for known sites was used in the Step 1 Analysis:

High	Medium	Low
Occupation	Subsurface Lithics	Surface Lithics
Fire Hearth	Bison kills	
Petroglyphs	Quarry	
Pictographs	Rock Cairns	
Rock Art	Tipi Rings	
Conical Pole Lodges	Historic Trails (not on National Register)	
Cribbed Log Structures		
Burial	Lookout	
Technology		
Arts		
Military Affairs		
Homestead		
Political Affairs		
Bison Drive with Compound		
Sites on or Eligible for National Register		

Higher site density does not necessarily reflect greater historical or research value for the more intensively used area or individual sites within it. All areas and sites have some research value. The potential for physical impact increases with site density and size, but impact may, in fact, be more severe if it occurs on a site in a low density area. On the basis of research value, it would be difficult to justify one corridor route over another. From the management perspective of desirability to avoid impact, when numbers of sites is weighed against factors such as age and spatial and temporal extent of sites, corridor selection is not\at all clearcut.

Determinant Value

The prehistoric and historic determinant was given a value of 2 on a scale of 1 to 3. This recognizes a compromise between the relatively high importance given this resource by a select group of professional and nonprofessional people and the lower importance placed on this resource relative to other concerns of many Montanans. This fact was established in public opinion polls and through the analysis of other public comment. Additionally, if project impact on sites cannot be avoided, salvage of scientific data from prehistoric and historic sites is a possible mitigation measure.

Human Population

Definitions

Population Density - refers to the distribution of individuals throughout a specific unit area of the study area, including the urbanized population based on 1970 census data (see Figure III-15).

Proximity - refers to the location of population centers with respect to the corridor segments being analyzed.

Development and Maps

Population dispersion within five miles of each corridor segment was examined using the "Population Density" map (Figure III-15). The population density of those sections of the study area crossed by corridor segments was then categorized as follows:

Category	Density (pop/sq. mile)
high	≥ 50
medium	5-49
low	< 5

Population centers located within one mile of a corridor segment were then factored into this data base. Although all such areas were rated high, the length of segment involved depended on the following criteria:

Miles Impacted	Pop. Center Size
0.5	<500
1	500-1000
2	>1000

These data were combined with the dispersed population density data mapped previously to provide an information base on human population for the areas crossed by segments.

Composition and Value of Data Items

This determinant includes all of the data items identified under Population Density and Proximity (see Figure IV-4). The values assigned to these data items are as follows:

Data Item	Value
<5 inhabitants per square mile	low (1)
5-49 " " " "	medium (2)
≥50 " " " "	high (4)
Pop. center crossed by, or within one mile of corridor segment	high (4)

In developing the Human Population determinant, it was considered that the greater the concentration of people, the greater the potential impact. Consequently, the appropriate number analog was assigned to the data items listed above.

Determinant Value

The Human Population determinant was assigned a value of 2 on a scale of 1 to 3. This reflects the moderate to high short-term impacts on communities expected from construction activities and the low to moderate probability of long-term adverse impact.

Scenic Quality

Definitions

The scenic quality analysis is based upon a systematic landscape classification of landforms, vegetation, and water features.

The Parks and Recreation Division of the Montana Department of Fish and Game in Helena, Montana in 1974, prepared a scenic analysis specifically for this project under contract to the Energy Planning Division of the Montana State Department of Natural Resources. The basic data for the Colstrip scenic analysis were taken directly from this scenic analysis.

Development and Maps

The methodology used by the State of Montana is as follows:

> Four items were taken into consideration for this analysis--land forms, vegetation, water features, and intrusions. Basically, it was assumed that the more varied the terrain, the more scenic; for vegetation, it was assumed that trees are more scenic than grasses but that variety is more scenic than a solid mass of either; water features were looked at from the standpoint of amount and variety. An area with many small streams and lakes could possibly be more scenic than a single large stream. Intrusions would consist of anything manmade that might detract from the view.

> "After rough evaluations were completed . . . map overlays were prepared . . . and taken to the areas for field review. Due to time limitations, this review was done by plane. After the field review . . . corrections were made by area specialists and the final scenic areas were transferred to one-half inch to the mile overlays (Joppa 1974).

The final rating system used by the Montana parks and Recreation Division was modified as shown below to fit the Colstrip Transmission Study methodology:

TER Step 1 Rating	Description	Montana State's Categories*
High	Exceptional	National Significance
	Very Scenic	Regional Significance
Medium	Scenic	State Significance
	Fair	Sub-state Significance
Low	Poor	Local Significance
	No Scenic Value	

*See Appendix A-2 for the rating criteria used by the Montana Fish and Game Department to produce these scenic quality ratings.

Because the scenic analysis prepared by the Montana Department of Fish and Game considered many of the same basic landscape features as those called for BLM and FS directives, it was judged adequate for Step 1.

Composition and Value of Data Items

The scenic quality determinant consists of the scenic quality data item. High scenic quality areas were rated high for potential impact, medium scenic quality areas were rated moderate, and low scenic quality areas were rated low.

Determinant Value

Montana's scenery, including that within the study area, is considered by many people as one of the State's most important resources. "The highways of Montana [are regarded as] among America's finest and have been designed to allow the traveller to enjoy . . . a setting of supreme natural beauty . . . [Montanans are] proud of the fact [they've] kept it that way" (Sol no date).

The dollar value of Montana's scenery is at least partially visible in the $205 million dollars made by the tourist industries of the state in 1976. America's movie and TV industries use the state's wealth of natural scenery and wildlife resources and contribute directly to the state's economy. Montana has gained three nicknames that testify to the value people place on its scenery - "Big Sky Country", "Land of the Shining Mountain", and "Last of the Big Time Splendors."

The team rated the overall value of this determinant as high (3 on a scale of 1-3) in comparison to the rest of the determinants.

Visual Sensitivity

Definitions

Scenic Travelways - This data item includes all of the travel routes (interstate, primary and secondary highways, roads and trails) within the study area administered by Federal, state, county or local governments that do not have man-made intrusions of a nature and magnitude that would cause a significant detraction to the viewing experience of the traveler.

Recreation Waterways - The Parks Division of the Montana Department of Fish and Game has declared the waters better suited to recreation use in the state as a recreational waterway system. The primary values of this waterway system are viewing outstanding scenery, high quality fishing, and river floating.

Development and Maps

Using criteria developed by the USDA Forest Service (1974c), three sensitivity levels were used to estimate people's concern for the visual environment surrounding the Applicant's proposed corridor and the alternative corridors. These visual sensitivity levels differ as follows (also see Table IV-3):

Sensitivity Level 1 includes all seen areas from primary travel routes, use areas, and water bodies where an estimated 75 percent or more of the users had a major concern for the scenic qualities. Sensitivity Level 1 also includes all seen areas from secondary travel routes, use areas, and water bodies where an estimated 75 percent of the users had a major concern for the scenic resources. All roads classifies as "scenic highways" and all roads and trails leading directly to major areas of interest; (i.e., national parks, wilderness areas, major recreation areas, historic sites, etc.) were assigned a Sensitivity Level 1 value.

Sensitivity Level 2 includes all seen areas from primary travel routes, use areas, and water bodies where an estimated 25 percent of the users had a major concern for scenic qualities. Level 2 also includes all seen areas from some secondary travel routes, use areas, and water bodies where an estimated 25 percent or more of the users had major concern for scenic qualities.

Sensitivity Level 3 includes all seen areas from secondary travel routes, use areas, and water bodies where it was believed less than 25 percent of the users had a major concern for scenic qualities (Level 3 does not include any areas seen from primary routes or areas).

Table IV-3. SUMMARY OF VISUAL SENSITIVITY LEVELS

Use	Sensitivity Level*		
	1	2	3
Primary Travel Routes, Use Areas, and Water Bodies	At Least 25%	Less than 25%	
Secondary Travel Routes, Use Areas, and Water Bodies	At Least 75%	At Least 25% Not More than 75%	Less than 25%

* - Percent of users having MAJOR concern for scenic qualities. For Step 1 of the Colstrip Transmission Corridor Study, these percentages were estimated. They were not obtained by an on-the-ground survey. These percentages are provided as a guide only, to indicate the relationship between the types of users and their concerns for aesthetics.

All travel routes, use areas, and water bodies within the study area were identified as being of either primary or secondary importance. The following list provides the general method used for determining in which category each facility belongs (determinants such as national or local importance may not apply to all routes and areas):

Facility	Primary Importance	Secondary Importance
Travel Route	National importance High use volume Long use duration access roads	Local importance Low use volume Short use duration
Use Areas	National importance High use volume Long use duration Large size	Local importance Low use volume Short use duration
Water Bodies	National importance High fishing use High boating use High swimming use	Local importance Low fishing use Low boating use Low swimming use

Sensitivity levels were determined and mapped for all corridor Visual Influence Zones (seen areas) from 1:250,000 USGS quadrangles.

Table IV-4 correlates the primary and secondary travel routes and use areas identified for this analysis and their corresponding levels of sensitivity.

Table IV-4 - SUMMARY OF PRIMARY AND SECONDARY TRAVEL ROUTES AND USE AREAS

	PRIMARY	SECONDARY	
Travel Routes and Use Areas Levels:	1	1 and 2*	2 and 3*
Interstate Freeways (I-15, I-90, I-94)	X		
State Hwy. System (paved roads)	X		
Secondary Roads (maintained gravel and dirt)		X	X
Wilderness and Primitive Areas	X		
Roadless Areas	X	X	X
Natural Areas	X	X	
Game Refuges and Ranges	X	X	
State Parks and Recreation Areas	X		
National Register Sites	X		
National Historic Trails	X		
Cities, Towns, Suburban and High Use Agricultural Areas	X		
Recreation Waterways	X	X	
Seldom Seen Areas			X

*Relationship to Sensitivity Levels

Composition and Value of Data Items

The Visual Sensitivity determinant consists of the scenic travelways, recreation waterways, and the visual sensitivity data items. Both scenic travelways and recreation waterways were rated as being highly sensitive to visual impact (4). The Level 1 visual sensitivity zones were rated high (4) for potential for visual transmission line impacts; Level 2 visual sensitivity zones, moderate (2); and Level 3 sensitivity zones, low (1).

Determinant Value

Public participation in determining location alternatives for the Colstrip transmission line, as recorded by the State of Montana Department of Natural Resources and Conservation, shows that there is a high concern for aesthetic values. The Study Team voiced the same concern and rated this determinant high (3).

Legal Constraints

The Legal Constraints determinant considers all areas where existing legislation restricts the use of land for transmission facilities. Where resources were considered significant enough to warrant Federal or state protection, they were considered an obvious constraint to transmission corridor location. Data items under this determinant include locations of threatened and endangered species of wildlife and vegetation, wild and scenic rivers, National Register sites, and natural areas established by special legislation or administrative action. Encountering any of these areas would constitute a "no go" situation. Consequently, no number values were needed since such constraints are essentially "absolute."

RESULTS

SEGMENT IMPACT SCORES

Using the methodology described earlier in this chapter, impact scores were derived for each corridor segment identified in previous reports (see Figure IV-3). Impact scores for each determinant are shown by segment in Table IV-5. The sum of all determinant impact scores is the total segment impact score, as presented in column Q of Table IV-5. These values were used to evaluate which segments should be retained for detailed analysis and which should be eliminated. The magnitude of the more important basic units of each determinant is indicated, by segment, in Table IV-6.

SEGMENT COMPARISONS FOR DETERMINING CORRIDORS WITH LEAST IMPACT

Segments which could serve in each of three plans-of-service (i.e., Great Falls, Helena, and Butte-Anaconda) were specified by the Project's Systems Engineer (see Figure IV-2). From each of these three networks of segments, a least-impact corridor was identified by eliminating one of a pair of segments between the same points in the corridor. Segment pairs were compared for total impact scores through a logical progression and only the lowest-impact segments for each portion of the corridor were retained. (The stepwise progression of these comparisons is presented at the end of this section). The Applicant's proposed corridor, plus their alternative corridor around the Flathead Indian Reservation (Siegel Pass Alternative) were retained for detailed analysis in Steps 2 and 3.

In some cases, combinations of segments (called links) were compared in pairs to identify least-impact links between more widely spaced points on the corridor. Each segment or link was included in as many comparisons as was logical before a final decision was made. For example, certain segments considered parts of more than one plan-of-service required comparison in each network.

Table IV-5 - SEGMENT ANALYSIS AND EVALUATION (STEP 1)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
		DETERMINANT IMPACT SCORES															
		NATURAL					ECONOMIC			SOCIAL				VISUAL			
SEGMENT	TOTAL LENGTH (miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LAND	COMMERCIAL FOREST LAND	RANGELAND	RECREATION USE	LAND MANAGEMENT PLANS**	PREHISTORIC AND HISTORIC	HUMAN POPULATION	SCENIC QUALITY	VISUAL SENSITIVITY	TOTAL SEGMENT IMPACT SCORE	AVERAGE SEGMENT IMPACT SCORE PER MILE
A-1	57.2	316	168	62	260	0	78	201	174	249	#C	146	213	456	480	2803	49
A-1-1	11.0	26	43	11	73	0	10	49	36	28	-	22	31	66	132	527	48
A-1-2	4.7	16	19	5	23	0	0	7	5	23	-	11	19	28	56	212	45
A-2	32.0	204	127	32	160	0	8	89	64	100	-	104	172	175	384	1619	51
A-3	25.8	88	63	26	105	0	25	23	26	80	-	64	66	155	171	892	35
A-4	10.7	44	21	11	43	0	0	0	11	21	-	21	21	32	64	289	27
A-4-1	3.4	12	7	3	13	0	2	0	3	7	-	11	7	20	10	95	28
A-5	44.4	100	110	46	178	0	17	4	44	173	-	105	223	204	464	1668	38
A-6	69.7	170	245	95	234	24	226	16	104	333	-	151	295	397	694	2984	43
A-7	70.9	212	275	105	238	0	222	17	106	259	-	154	322	373	760	3043	43
A-8	58.4	138	209	89	224	0	71	31	58	274	-	201	270	350	519	2434	42
A-9	36.5	76	134	67	164	0	38	28	121	126	-	73	73	113	178	1191	33
A-10	29.9	60	120	63	101	25	50	0	30	120	-	98	66	90	296	1119	37
A-11	47.3	104	189	88	167	0	87	29	63	332	-	127	243	195	568	2192	46
A-12	18.0	44	72	33	61	0	32	0	39	136	-	84	72	83	216	872	48
A-13	77.3	166	282	136	283	24	61	1	127	185	-	259	179	352	439	2494	32
											-						
B-1*	16.1	32	55	16	60	0	16	0	16	67	-	106	46	72	193	679	42
B-2	15.9	36	44	16	58	0	14	0	16	66	-	60	68	95	191	664	42
B-3	19.8	52	58	20	112	0	13	49	20	64	-	40	81	119	238	866	44
B-3-1	17.8	64	71	18	132	0	0	91	62	52	#	38	71	168	202	969	54
B-4	24.0	140	119	31	188	22	5	233	39	147	#	58	48	228	19	1477	62
B-4-1	3.9	32	10	4	31	0	0	23	4	31	-	16	8	23	47	229	59
B-4-2	16.6	84	76	19	129	0	0	142	42	46	-	37	34	97	107	813	49
B-5	6.3	48	13	6	28	0	0	8	7	13	-	13	13	38	76	263	42
B-5-1	7.4	44	23	7	50	0	0	61	7	15	-	15	15	40	89	366	49
B-6	8.9	30	31	9	35	0	2	0	9	20	-	22	21	53	81	313	35
B-7	10.3	26	35	10	41	0	0	0	24	37	-	47	20	62	111	413	40
B-8	12.7	30	50	13	74	0	0	70	28	44	-	31	25	74	66	505	40
B-9	22.9	60	84	23	114	0	24	84	36	67	-	70	60	137	206	965	42
B-10	6.1	24	14	6	23	0	6	0	6	25	-	18	24	37	50	233	38
B-11	7.4	14	18	7	35	0	8	23	7	59	-	15	15	43	53	297	40
B-12	5.1	16	16	5	32	24	0	34	5	41	-	14	10	31	61	289	57
B-12-1	5.2	12	14	7	19	0	8	0	5	42	-	10	13	31	62	223	43
B-12-2	19.6	54	45	20	72	0	25	0	20	56	-	39	78	100	139	648	33
B-13	9.8	40	71	34	58	15	2	30	10	78	XC	20	20	59	118	555	57
B-14*	8.6	20	31	16	43	0	0	26	9	69	-	63	20	26	95	418	49
B-15	17.7	58	134	65	120	12	0	58	22	142	#	35	35	99	212	992	56
B-16	11.6	38	93	46	90	3	0	130	30	93	X	49	23	70	139	804	69
B-16-1	3.0	6	24	12	14	0	0	6	3	24	-	28	24	18	36	195	65
B-17	39.2	182	179	87	239	0	26	101	39	198	C	84	109	250	302	1796	46
B-18	8.9	20	52	26	34	0	18	7	13	61	-	26	36	53	107	453	51
B-19	8.8	18	21	9	30	0	22	0	11	70	-	18	35	53	106	393	45
B-20*	40.2	88	175	87	160	0	21	18	49	136	XC	286	151	121	391	1683	42
B-21	38.6	108	116	52	162	0	24	54	66	100	-	117	79	214 E	329	1421	37
B-22*	25.6	70	85	35	101	0	39	38	35	74	-	53	64	133 E	169	896	35
B-23	22.0	86	66	28	92	0	31	47	30	81	-	44	56	102	209	872	40
B-24	58.1	140	161	79	227	4	72	50	86	122	X	146	116	356	379	1938	33
B-25	19.6	58	69	34	97	0	12	66	20	70	-	55	43	118	127	769	39
B-26	21.3	56	68	31	77	0	28	0	21	73	-	55	65	128	145	747	35
B-27	27.9	60	116	56	99	0	38	0	28	97	-	62	56	102	154	868	31
B-28	50.3	100	193	97	176	0	50	0	112	190	X	105	101	153	255	1532	30
B-29*	24.6	80	56	33	102	34	16	0	39	56	-	97	49	91	132	785	32
B-30	12.8	26	28	14	41	0	20	0	27	38	-	94	26	38	100	452	35
B-31*	21.3	46	43	21	105	0	1	15	30	43	-	75	43	64	64	550	26
B-32	77.5	330	275	131	411	0	48	88	170	241	-	187	172	273	668	2994	39
B-33*	65.5	160	236	111	301	0	16	34	131	197	-	199	164	290	332	2171	33
C-1	8.7	30	17	9	24	0	28	0	14	70	-	47	17	75	104	435	50
C-2	7.6	20	15	8	21	24	30	0	15	61	-	43	18	66	91	412	54
C-3*	26.3	92	69	26	143	0	39	113	44	210	-	125	55	170	272	1358	52
C-4*	12.2	24	49	15	98	0	0	106	12	98	-	30	24	73	80	609	50
C-5	18.4	36	51	25	78	0	44	39	18	147	-	61	118	55	221	893	49
C-6	3.7	8	7	4	7	0	14	0	4	30	-	9	30	22	44	179	48
C-7	18.0	68	51	23	119	5	12	100	18	113	#	76	68	108	216	977	54
C-8	106.1	312	392	161	395	42	206	118	138	695	X	284	227	597	1175	4742	45
C-9	62.3	160	212	98	282	9	24	115	91	240	#	153	139	298	604	2425	39
C-10*	31.0	58	129	65	120	7	14	0	31	94	X	78	62	93	218	979	32
C-11	35.7	78	142	69	127	0	58	0	36	117	-	85	71	194	278	1255	35
C-12*	77.7	164	267	133	172	0	85	0	104	211	-	157	155	233	368	2049	26
D-1*	19.7	48	55	20	72	0	29	0	20	158	-	51	80	154	236	923	47
D-2	6.4	14	18	6	26	0	0	0	6	38	-	19	26	38	77	268	42
D-3*	14.8	96	70	19	110	114	0	137	15	118	-	30	40	144	178	1071	72
D-4*	43.8	258	145	47	294	44	21	250	87	350	X#	100	116	337	526	2575	59
D-5*	4.9	12	10	5	12	0	28	0	5	39	-	34	10	44	59	258	53
D-5-1	26.8	174	86	27	175	0	9	108	51	214	#	86	56	191	222	1399	52
D-6	10.1	64	29	10	51	2	25	56	27	81	X	44	20	74	121	604	60
D-7	6.2	32	20	6	45	3	0	60	20	50	X	22	12	40	74	384	62
D-8	41.1	256	126	55	260	210	3	203	96	317	X	106	112	401	404	2549	62
D-9	47.3	198	163	51	294	7	19	167	78	317	X	109	119	214	393	2129	45
D-10	49.5	172	184	83	187	0	38	12	89	169	-	115	113	191	248	1601	32
D-11	58.6	242	173	76	350	0	13	178	72	277	-	135	117	464	348	2445	42
D-12	91.0	194	275	131	281	0	173	0	153	243	-	200	426	283	719	3078	34
D-13	28.4	80	76	38	114	0	0	0	28	65	-	57	57	130	161	806	28
D-14	76.7	182	208	103	292	0	77	53	148	120	-	155	180	314	488	2320	30
D-15	36.0	84	144	69	127	0	33	0	37	99	-	96	75	139	253	1156	32

* Applicants' Proposed Corridor

** Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

X - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table IV-6 - SEGMENT SUPPLEMENTAL QUANTITATIVE INFORMATION (STEP 1)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
SEGMENT	LENGTH IN MILES	FEDERAL LANDS (miles)	INDIAN LANDS (miles)	STATE & PRIVATE LANDS (miles)	FOREST LAND/HIGH IMPACT POTENTIAL (miles)	AGRICULTURAL LAND/IRRIGATED (miles)	RANGELAND-HIGH IMPACT POTENTIAL (miles)	WATER BODIES CROSSED/CLASS I & II FISHING STREAMS CROSSED	HIGH SEDIMENT RISK (miles)	POOR SUITABILITY FOR TRANSMISSION LINES (miles)	100 KV AND ABOVE PARALLEL FOSSIL FUEL FACILITIES (miles)	SCENIC HIGHWAYS (crossed/parallel) (miles)	NATIONAL REGISTER SITES	NATIONAL SCENIC TRAILS (crossed/parallel) (miles)	RECREATION SITES	ARCHEOLOGICAL/HISTORICAL SITES CROSSED BY CORRIDOR (based on township rg. loc.)	ELK WINTER RANGE/KEY AREAS (miles)	MULE DEER, WHITE-TAILED DEER, PRONG HORNED ANTELOPE - KEY AREAS (miles)	GRIZZLY BEAR HABITAT (miles)
A-1	57.2	28.4	0	28.8	19.2/14.3	10.4/ 9.2	38.8	44/0	0	4.4	12/ 0	2/3	0	0/ 0	7	16	18/2	1	0
A-1-1	11.0	1.0	7.1	2.9	8.1/ 0	1.9/ 0.5	8.2	1/0	0	0	0/ 0	1/1	0	0/ 0	4	0	0/0	1	0
A-1-2	4.7	0	0	4.7	1.1/ 0	0/ 0	0	2/0	0	0	4/ 4	0/1	0	0/ 0	0	1	0/0	0	0
A-2	32.0	4.9	0	27.1	8.5/ 6.3	1.0/ 1.0	10.6	11/1	0	0	31/31	2/2	0	1/ 0	9	16	0/0	0	0
A-3	25.8	0.3	0	25.5	1.9/ 1.9	3.1/ 3.1	0	13/0	0	0	24/24	2/2	0	0/ 0	5	6	4/0	3	0
A-4	10.7	0	0	10.7	0/ 0	0/ 0	0	7/0	0	0	11/18	0/0	0	0/ 0	2	0	6/0	0	0
A-4-1	3.4	0.7	0	2.7	0/ 0	0.3/ 0.3	0	2/0	0	0	3/ 3	0/0	0	0/ 0	0	2	0/0	0	0
A-5	44.4	3.1	0	41.3	1.2/ 0	2.1/ 2.1	0	26/0	.5	.5	44/ 0	4/3	2	1/ 0	9	8	5/1	0	0
A-6	69.7	5.2	0	63.5	5.2/ 0	32.9/23.7	0	46/1	5.6	5.6	30/ 0	5/5	2	2/ 5	11	6	0/0	16	0
A-7	70.9	11.0	0	59.9	5.7/ 0	34.3/21.3	0	39/2	4.1	4.1	15/25	3/3	1	2/ 15	7	6	2/0	31	0
A-8	58.4	1.2	0	57.2	2.6/ 2.6	10.1/ 7.6	0	26/0	0	0	14/ 0	2/3	0	0/111	15	24	0/0	29	0
A-9	36.5	0.5	0	36.0	9.2/ 0	9.6/ 0	28.3	18/0	0	0	36/ 0	0/0	0	0/ 0	0	0	0/0	2	0
A-10	29.9	0	0	29.9	0/ 0	12.5/ 0	0	7/0	0	0	0/ 0	1/1	0	1/ 0	4	19	0/0	0	0
A-11	47.3	0	7.2	40.1	2.4/ 0	15.7/ 6.0	5.2	32/0	0	0	18/ 0	1/0	1	2/ 0	0	16	0/0	2	0
A-12	18.0	0	0	18.0	0/ 0	5.5/ 2.5	7.0	14/0	0	0	0/ 0	3/3	0	0/ 0	0	24	0/0	2	0
A-13	77.3	0	0	77.3	0.3/ 0	13.8/ 1.5	7.1	38/0	0	0	81/17	1/2	0	0/ 0	2	52	0/0	3	0
B-1*	16.1	0	16.1	0	0/ 0	2.4/ 1.5	0	9/0	0	0	16/ 0	0/0	0	0/ 0	0	37	0/0	0	0
B-2	15.9	0	15.7	.2	0/ 0	2.7/ 0.9	0	7/0	0	0	16/ 9	1/1	0	0/ 0	4	10	0/0	2	0
B-3	19.8	0.7	16.5	2.6	9.1/ 0	1.6/ 1.6	0	14/0	0	0	20/20	1/1	0	0/ 0	2	0	1/0	2	0
B-3-1	17.8	8.3	0	9.5	15.2/ 0	0/ 0	14.6	4/1	0	0	3/ 0	1/1	0	1/ 0	2	1	0/0	0	0
B-4	24.0	11.0	9.7	3.3	23.4/15.7	0.6/ 0.6	5.1	16/1	0	6.6	0/ 0	1/1	0	1/ 0	0	5	0/4	0	2
B-4-1	3.9	0	0	3.9	3.9/ 0	0/ 0	0	2/0	0	0	3/ 0	0/0	0	0/ 0	0	4	0/0	0	0
B-4-2	16.6	3.0	0	13.6	15.6/ 8.1	0/ 0	8.5	3/0	0	2.9	18/ 0	1/1	0	0/ 0	0	2	0/0	0	0
B-5	6.3	0.4	0	5.9	.7/ .7	0/ 0	0.3	1/0	0	0	7/ 7	1/2	0	0/ 0	2	0	0/0	0	0
B-5-1	7.4	0	0	7.4	5.1/ 5.1	0/ 0	0	2/0	0	0	7/11	1/2	0	0/ 0	1	0	0/0	0	0
B-6	8.9	0	0	8.9	0/ 0	0.2/ 0.2	0	4/0	0	0	11/11	0/1	0	0/ 0	0	2	0/0	0	0
B-7	10.3	0.2	0	10.1	0/ 0	0/ 0	4.5	3/0	0	0	0/ 0	0/0	0	0/ 0	0	10	0/0	0	0
B-8	12.7	0	0	12.7	5.8/ 5.8	0/ 0	5.1	2/0	0	0	12/ 0	0/0	0	0/ 0	0	3	0/0	0	0
B-9	22.9	0	0	22.9	7.0/ 7.0	3.0/ 3.0	4.5	9/0	0	0	7/25	1/1	0	1/ 0	6	12	2/0	0	0
B-10	6.1	0	0	6.1	0/ 0	0.9/ 0.5	0	2/0	0	0	6/ 0	1/0	0	1/ 0	4	3	0/0	1	0
B-11	7.4	0.1	0	7.3	1.9/ 1.9	1.1/ 1.0	0	5/0	0	0	0/ 0	0/0	0	0/ 0	0	0	0/0	0	0
B-12	5.1	0.7	0	4.4	2.8/ 2.8	0/ 0	0	1/0	0	0	0/ 3	1/1	0	1/ 24	0	2	0/0	0	0
B-12-1	5.2	0	0	5.2	0/ 0	1.0/ 1.0	0	1/0	0	0	0/ 4	1/1	0	1/ 0	0	0	0/0	0	0
B-12-2	19.6	0.1	0	19.5	0/ 0	3.1/ 3.1	0	5/0	0	0	0/ 0	1/0	0	0/ 0	1	0	6/0	0	0
B-13	9.8	7.8	0	2.0	4.9/ 1.7	0.2/ 0.2	0	3/0	7.9	7.9	0/ 0	0/0	0	1/ 0	5	0	4/0	1	0
B-14*	8.6	1.0	0	7.6	2.2/ 2.2	0/ 0	0	2/0	0	0	0/ 0	1/1	0	1/ 0	0	11	0/0	0	0
B-15	17.7	15.0	0	2.7	12.3/ 2.3	0/ 0	1.5	8/0	15.7	15.7	0/ 0	0/0	0	1/ 0	4	0	2/0	0	0
B-16	11.6	4.5	0	7.1	10.8/10.8	0/ 0	6.0	3/0	11.6	11.6	0/ 0	0/0	0	0/ 0	0	1	0/0	0	0
B-16-1	3.0	2.0	0	1.0	0.5/ 0.5	0/ 0	0	1/0	3.0	3.0	0/ 0	0/0	0	0/ 0	0	11	0/0	0	0
B-17	39.2	21.6	0	17.6	22.1/ 3.8	3.3/ 3.3	0	20/0	11.6	11.6	0/ 0	2/1	0	1/ 0	0	3	5/12	0	0
B-18	8.9	1.1	0	7.8	0.6/ 0.6	2.2/ 2.2	1.5	5/0	5.7	5.7	0/ 2	1/1	0	0/ 0	0	4	0/0	0	0
B-19	8.8	0	0	8.8	0/ 0	2.7/ 2.7	0	1/0	0	0	0/ 0	0/0	0	0/ 0	2	0	0/0	2	0
B-20*	40.2	11.3	0	28.9	1.5/ 1.5	3.6/ 1.6	0	10/0	8.0	8.0	27/34	1/0	1	0/ 0	6	67	0/2	4	0
B-21	38.6	4.1	0	34.5	4.5/ 4.5	5.0/ 1.0	0	17/0	0	0	0/ 0	1/1	0	1/ 0	0	20	6/0	6	0
B-22*	25.6	6.0	0	19.6	3.2/ 3.2	7.0/ 2.8	0	4/1	0	0	0/ 0	1/1	0	1/ 0	0	1	6/0	2	0
B-23	22.0	4.5	0	17.5	3.9/ 3.9	5.8/ 2.0	0	5/1	0	0	0/ 6	1/1	0	1/ 0	1	0	10/0	2	0
B-24	58.1	7.6	0	50.5	5.7/ 3.7	14.0/ 4.0	0	26/1	0	0	34/ 0	1/1	0	1/ 0	5	13	2/0	8	0
B-25	19.6	5.0	0	14.6	5.5/ 5.5	1.5/ 1.5	0	8/0	0	0	0/ 0	0/0	0	0/ 0	0	8	4/0	6	0
B-26	21.3	0	0	21.3	0/ 0	4.3/ 2.6	0	10/0	0	0	20/ 0	1/1	0	1/ 0	0	6	0/0	2	0
B-27	27.9	0	0	27.9	0/ 0	6.3/ 3.1	0	15/0	0	1.0	28/ 0	1/1	0	0/ 0	0	3	0/0	8	0
B-28	50.3	0.7	0	49.3	0/ 0	12.6/ 0	18.9	31/0	0	0	0/ 0	0/0	0	1/ 0	0	2	0/0	2	0
B-29*	24.6	0	0	24.6	0/ 0	4.0/ 0	4.8	12/0	0	0	25/ 0	2/2	1	0/ 0	0	24	0/0	3	0
B-30	12.8	1.7	0	11.1	0/ 0	5.0/ 0	4.7	10/0	0	0	0/ 0	1/1	0	0/ 0	0	29	0/0	0	0
B-31*	21.3	1.6	0	19.7	5.0/ 0	0.2/ 0	2.9	10/0	0	0	20/ 0	0/0	0	0/ 0	0	16	0/0	0	0
B-32	77.5	3.7	0	73.8	29.3/ 0	7.9/ 4.0	15.1	46/0	0	0	17/ 0	1/0	0	0/ 0	2	16	0/0	9	0
B-33*	65.5	0.5	0	65.0	11.3/ 0	3.1/ 0.8	10.8	37/0	0	0	68/ 0	2/1	0	0/ 0	0	34	0/0	8	0
C-1	8.7	1.0	0	7.7	0/ 0	5.2/ 1.7	1.8	3/0	0	0	8/ 0	0/0	0	0/ 0	0	15	0/0	2	0
C-2	7.6	0	0	7.6	0/ 0	4.5/ 3.0	2.5	4/0	0	0	0/ 0	0/0	0	0/ 0	0	14	0/0	1	0
C-3*	26.3	2.0	0	24.3	12.1/ 6.8	5.4/ 4.4	5.8	11/0	0	0	0/ 0	0/0	0	0/ 0	2	36	2/0	0	0
C-4*	12.2	9.4	0	2.8	12.2/ 7.7	0/ 0	0	2/0	0	0	0/ 0	0/0	0	2/ 0	0	3	0/0	0	0
C-5	18.4	2.3	0	16.1	5.5/ 1.0	9.0/ 1.9	0	11/0	0	0	0/ 0	1/0	1	1/ 0	3	12	0/0	0	0
C-6	3.7	0	0	3.7	0/ 0	3.6/ 0	0	2/0	0	0	0/ 0	0/0	0	0/ 0	0	1	0/0	0	0
C-7	18.0	3.7	0	14.3	12.8/ 3.8	2.3/ 0.8	0	8/0	0	0	0/ 0	0/0	0	2/ 0	3	20	0/0	5	0
C-8	106.1	9.2	0	96.9	9.8/ 9.8	34.5/16.9	0	55/0	0	0	48/ 8	3/3	1	3/ 28	3	36	5/0	44	0
C-9	62.3	9.8	0	52.5	9.6/ 9.6	3.0/ 3.0	9.7	30/0	0	0	0/ 0	2/2	0	1/ 0	1	14	0/6	5	0
C-10*	31.0	3.0	0	28.0	0/ 0	1.8/ 1.8	0	5/0	2.2	2.2	0/ 0	1/1	0	1/ 0	0	8	2/2	3	0
C-11	35.7	0	0	35.7	0/ 0	7.7/ 6.9	0	14/0	.9	1.9	0/ 0	1/1	0	2/ 0	0	7	0/0	1	0
C-12*	77.7	0	0	77.7	0/ 0	19.3/ 2.0	0	46/0	0	0	0/ 0	1/1	0	0/ 0	0	1	0/0	14	0
D-1*	19.7	0	19.5	.2	0/ 0	3.6/ 3.6	0	11/0	0	0	18/ 0	1/1	1	0/ 0	1	6	0/0	0	0
D-2	6.4	0	6.0	.4	0/ 0	0/ 0	0	3/0	0	0	0/ 0	1/1	0	0/ 0	2	3	0/0	2	0
D-3*	14.8	0	14.8	0	12.6/10.2	0/ 0	0	10/0	0	4.0	14/ 0	0/0	0	0/ 0	2	0	2/0	3	11
D-4*	43.8	14.8	5.0	24.0	31.7/15.3	3.9/ 1.3	14.5	17/3	0	3.1	43/ 0	1/1	0	1/ 0	5	6	7/0	0	4
D-5*	4.9	0	0	4.9	0/ 0	4.0/ 3.0	0	1/0	0	0	0/ 0	0/0	0	0/ 0	0	12	0/0	1	0
D-5-1	26.8	6.3	0	20.5	18.0/ 0	2.2/ 0	8.0	9/0	0	0	0/ 0	0/0	0	0/ 0	2	16	1/0	0	0
D-6	10.1	2.7	0	7.4	4.7/ 4.7	4.2/ 2.0	5.5	4/0	0	0	9/ 0	1/1	0	0/ 0	0	12	0/0	1	0
D-7	6.2	3.8	0	2.4	5.0/ 5.0	0/ 0	4.7	1/0	0	0	0/ 0	0/0	0	0/ 0	0	5	1/0	0	0
D-8	4.1	3.4	0	37.7	24.0/13.0	0.4/ 0.4	18.2	28/0	0	0	40/ 0	1/1	0	1/ 0	10	12	0/0	2	0
D-9	47.3	6.5	0	40.8	28.5/ 4.8	4.5/ 0.2	10.9	13/0	0	0	0/ 0	1/0	0	4/ 0	1	7	4/5	11	0
D-10	49.5	1.2	0	48.3	1.0/ 1.0	7.6/ 2.0	13.0	25/1	3.0	3.0	0/ 0	2/1	0	2/ 0	0	8	10/1	17	0
D-11	58.6	3.0	0	55.6	29.7/ 0	1.6/ 1.6	4.4	23/0	0	0	10/ 0	0/0	0	1/ 0	2	9	2/0	27	0
D-12	91.0	0	0	91.0	0/ 0	41.5/ 1.8	0	46/0	0	0	91/15	4/3	2	4/ 12	8	9	0/0	12	0
D-13	28.4	1.0	0	27.4	0/ 0	0/ 0	0	18/1	0	0	0/ 0	1/1	0	0/ 0	1	0	0/0	14	0
D-14	76.7	2.0	0	74.7	4.4/ 4.4	16.2/ 3.1	0	63/0	0	0	80/ 0	2/2	0	2/ 17	3	1	0/0	7	0
D-15	36.0	0	0	36.0	0/ 0	8.3/ 0	0	17/0	0	0	32/ 7	1/1	0	1/ 0	0	12	0/0	6	0

* - Applicants' Proposed Corridor

Several criteria established for segment comparison were used to evaluate differences in impact. These criteria were as follows:

1. Total segment impact scores had to differ by 5% or more to give preference to the segment with the lower score. If upon dividing the larger impact score by the smaller score, the quotient was less than 1.05 (5% difference), then other criteria were used to help decide preference.

2. A higher total segment impact score may result from disproportionately large scores for only a few determinants of a given segment, whereas the majority of determinants may favor this segment. Thus, a segment having lower scores for more than half of the determinants was favored.

3. The average impact score per segment mile was considered important in evaluating segment differences. Where other criteria were not adequate to make a decision, this measure was used to help identify the more favorable segment.

4. Conflict between land management plans and the introduction of transmission facilities in specific areas could dictate which segment would be acceptable.

5. All logical comparisons for any segment had to be completed before the fate of that segment was decided.

6. Elimination of any segment or link in favor of its paired alternative had to receive unanimous approval by the Study Team. Any team member could request a review of determinant scores and further discussion before a final decision was made.

Using these decision criteria, a stepwise, binary comparison of segments and links was initiated at the Colstrip end and progressed to the Hot Springs/Plains terminal (see Figure IV-3). The segment between Hot

Springs and Plains was not considered because the proposed action was to terminate at one of these two points.

Segments in the Helena plan-of-service were compared first because this plan had the most alternative segments, including several which could serve as parts of the other plans-of-service. Segments in the Butte-Anaconda and Great Falls corridors were then compared. The comparisons followed logical progression based on (1) first considering all alternative segments or links which could be used to provide service between any two selected points and (2) then comparing between alternatives remaining after a segment or link was deleted.

The comparisons, along with a brief resume of the team's action for each, are detailed below, in order of consideration:

Helena Plan-of-Service

Comparison 1

		Impact Score		Score Differences (Larger÷Smaller)	
Segment(s)	Length(mi)	Total	Per Mile	Total	Per Mile
B32	77.5	2994	39	1.38	1.18
B33	66.5	2171	33		

The B32 segment has a total impact value 38 percent greater than B33. Some of the differences are due to shorter length of B33, but the impact per mile is also greater on B32 (by 18 percent). The decision was to delete B32, as it could not logically serve in any other comparisons.

Comparison 2

A10 + A12	47.9	1991	42		
A11	47.3	2192	46	1.10	1.10

The A11 segment was dropped due to its 10 percent higher total impact score. It could not logically serve in any other comparisons.

Comparison 3

B33+B31+B30	99.6	3173	32		
A13 + A12	95.3	3366	35	1.06	1.11

The "B" link, although slightly longer, had 6 percent less total potential impact than the "A" link in this comparison. The higher impact per mile for the "A" link (11 percent) counterbalanced its shorter distance. The decision was to retain the "B" link due to its smaller impact potential. Segments A12 and A13 were thus eliminated from further consideration.

Comparison 4

B29 + B28	74.9	2317	31		
B30+A10+A9	79.2	2762	35	1.19	1.13

The B30+A10+A9 link has a 19 percent higher total impact score and is 4.3 miles longer than the B29+B28 link, which thus was retained. Segments B30, A10 and A9 were dropped from further consideration.

Comparison 5

C8 + D15	142.1	5898	42	1.32	1.31
C9 + C12	140.0	4474	32		

The C9 + C12 link had nearly 1/3 less total impact potential than the C8 + D15 link. Segment C8 was not deleted, since it could serve in another link comparison. The D15 segment could not be eliminated, since it is a required portion of the Great Falls plan-of-service, although it was removed from further consideration as a part of the Helena plan-of-service.

Comparison 6

C6+D11+ D13+D14	167.4	5750	34.0	1.01	
C7 + C8	124.1	5719	46.0		1.35

In this comparison, the C7 + C8 route was much shorter, but the total impact score was essentially the same as for the much longer C6+D11+D13+D14 link. The very high impact score per mile of segment C8 was taken as adequate evidence, in conjunction with the adverse results of Comparison 5 above, to eliminate C8 from further consideration.

Comparison 7

C6+D11+D13+ D14+D15	203.4	6906	34	1.27	
C7+C9+C12	158.0	5451	35		1.03

In this comparison, the total impact score was directly proportional to the length of combined segment length, with only a 3 percent difference in the potential impact per mile of segment. Because the overall environmental impact would be 27 percent less on the shorter C7+C9+C12 link, the longer link was deleted as a feasible alternative in the Helena plan-of-service. Segment C6 was retained for further comparisons in other alternative links.

Comparison 8

C10 + C12	108.7	3028	28		
C11+B27+B28	113.9	3655	32	1.21	1.14

The C11+B27+B28 link had a higher average impact score per mile and it was longer than the C10+C12 link. Thus, it would have 21 percent higher potential impact. Segment C11 was deleted from further consideration, but B27 and B28 were retained for other alternative comparisons.

Comparison 9

B22+C10+C12	134.3	3924	29		
B23+B25+B26 B27+B28	141.1	4788	34.0	1.22	1.17

The higher impact score per mile, greater distance, and higher total impact score for the B23 through B28 link was evidence that the B22+C10+C12 link should be maintained. Only Segment B23 was dropped, however, because the other segments could serve in other link comparisons.

Comparison 10

B21+B25	58.2	2190	38	1.13	1.15
B24	58.1	1938	33		

These two links were almost identical in length, but the total impact score for B24 was 13 percent lower than that for the B21+B25 link. Therefore, the B21+B25 link was dropped from further comparisons.

Comparison 11

B20+B22+ C10+C12	174.5	5607	32.0		
B16-1+B16+ B18+B19+ B24+B26+ B27+B28	189.9	6930	36.0	1.24	1.13

The B20 through C12 link was shorter, had 13 percent less potential impact per mile, and a total impact score 24 percent lower than its pair. The B20-C12 link appeared to be superior from this comparison for the Helena plan-of-service, but before the B16-1 through B28 link could be dropped from this plan-of-service, additional comparisons were made as described in Comparisons 12 and 13 below.

Comparison 12

B13+B16	21.4	1359	64	1.37	1.14
B15	17.7	992	56		

The shorter B15 segment was considerably more favorable than the longer B13+B16 link between the two points in question. Segment B15 was included in place of B16-1 and B16 in Comparison 11 described above, and B13 plus B16-1 were added to the B20 through C12 link of that comparison. Results for this comparison would provide definitive information concerning which of these major links should be retained for the Helena plan-of-service. Results are outlined in Comparison 13.

Comparison 13

B13+B16+1+ B20+B22+ C10+C12	187.3	6357	34		
B15+B18+B19+ B24+B26+B27+ B28	193.0	6923	36	1.09	1.06

From this comparison, the B13-C12 link appears to be definitely lower in potential environmental impact than the B15-B28 link. The decision was made to retain the B20-C12 link for further comparisons in this plan-of-service. Segments B13 and B16-1 required further comparisons before they could be retained or rejected.

Comparison 14

D5 + D7	11.1	642	58	1.06	
D6	10.1	604	60		1.03

Power distribution to the point of juncture of D5 and D6 could be along either of these two alternatives. The impact per mile was three percent greater via D6, but the D5 + D7 link was about ten percent longer, making a decrease of six percent in the total impact score for D6. Therefore, to determine how segment D9 would fare in a link, the D6 segment was selected to couple with D9, as detailed in Comparison 15.

Comparison 15

D6+D9+C6	61.1	2912	48		
D5+C3+C4+C5	61.8	3118	50	1.07	1.04

The D6-C6 link appears favorable in this comparison. However, before any decision could be made, these two links required comparison as parts of longer links, as described in Comparisons 16 and 17.

Comparison 16

C5+C7+C9	98.7	4295	44	1.08	1.16
B14+B20+ B22+C10	105.4	3976	38		

Results of this comparison suggest the B14-C10 link to be more favorable. Step 17 further tests this result, plus the results of Step 15.

Comparison 17

D6+D9+C6+ C7+C9	141.4	6314	45	1.02	1.07
D5+C3+C4+ B14+B20+B22+ C10	148.8	6201	42		

When combined into this longer link, link D6+D9+C6 no longer survives as a preferential link. The apparent benefit of this link is overcome by the higher potential impact of the C7+C9 portion of the link. This result, plus that of Comparison 16 above, provided evidence that segments D9, C5, C6, C7 and C9 could be dropped from this plan-of-service. However, one additional comparison was made to test this conclusion. To do this, D7 was substituted for D6 in the upper link and D5 was dropped from the lower link. This would allow consideration of a routing to the junction of segments D7 and C3 from the junction of C9 and C10. Results are detailed in Comparison 18.

Comparison 18

D7+D9+C6+ C7+C9	137.5	6094	44	1.03	1.07
C3+C4+B14+ B20+B22+C10	143.9	5943	41		

Although the difference in total impact scores is less than five percent, the C3-C10 link is still somewhat more favorable than its alternative. It is slightly longer, but it has a seven percent lower score on a per mile basis. These data, plus supporting results from Comparisons 16 and 17, were considered sufficient to delete segments D7, D9, C5, C6, C7 and C9 from the Helena plan-of-service.

At this point, it was decided that the best way to determine the corridor of least impact in the western area where numerous segments intersect, was to work from the western terminals in a reverse direction. In this area, portions of the same corridor could serve more than one plan-of-service. The following steps detail this process.

Comparison 19

A1	57.2	2801	49	1.27	1.14
B1+B2+B3	51.8	2209	43		

Although these two links do not meet at the western end, a substation could be provided at either terminus. The overall impact of the B1-B3 link is 27 percent less than that of segment A1. Therefore, delivering power to Plains via the B1-B3 link would be preferable to the A1 route.

Comparison 20

B2+B3+ A1-2+B3-1	58.2	2711	47		
D1+D3+B4	58.5	3471	59	1.28	1.26

These two links were nearly identical in length, but the B2-B3-1 link was much lower in potential total impact. Only segment B4 could be deleted from this comparison.

Comparison 21

D1+D3+D4	78.3	4569	58	1.05	1.18
B2+B3+A1-2 +B3-1+B4-1 +D5-1	88.9	4339	49		

The D1-D4 link is shorter, but has a five percent greater potential total impact than the B2-D5-1 link. To provide further evidence, D2 was substituted for D1 in the former link and B2 was dropped from the latter link, and these two resulting links were compared in Comparison 22 below.

Comparison 22

D2+D3+D4	65.0	3914	60	1.07	1.20
B3+A1-2+B3-1 +B4-1+D5-1	73.0	3675	50		

These results further indicated that the B3-D5-1 link was preferred to the D2-D4 link. In this case, the longer route was retained because of its much lower impact score per mile. Segments D1, D2, D3 and D4 were deleted from further comparisons.

Comparison 23

A2+B5-1	39.4	1985	50		
B3-1+B4-1 +B4-2	38.3	2011	53	1.01	1.06

This comparison did not provide any definitive results. The decision to delete or retain these links would have to rest on how they compare when included in other links.

Comparison 24

A3	25.8	892	35		
B5-1+B5+B6+B10	28.7	1175	41	1.32	1.17

From this comparison it was obvious that segment A3 was highly preferable to the B5-1 through B10 link. However, only segment B5-1 could be deleted because the other segments required comparison in other links.

Comparison 25

A2+A3+A4-1+B12-2	80.8	3254	40		
B3-1+B4-1+B4-2+B5+B6+B9	76.4	3552	46	1.09	1.15

The A2-B12-2 link is somewhat longer than its alternative in this comparison, but it has nine percent less potential total impact. However, the final decision was deferred until other comparisons were made.

Comparison 26

D5-1+D5	31.7	1657	52		1.11
B4-2+B5+B7+C2	40.8	1901	47	1.15	

In this case, the shorter segment had a greater impact per mile, but a lower total impact score. Results of subsequent comparisons were combined with these to arrive at a decision on these segments.

Comparison 27

B9	22.9	965	42		1.24
B10+A4-1+B12-2	29.1	976	34	1.01	

No difference in total potential impact could be discerned from this comparison. The much longer link has a correspondingly lower impact score per mile of length. A decision on these segments had to await further comparisons.

Comparison 28

C4+B14	20.8	1027	49		
B11+B12+B13 +B16-1	25.3	1336	53	1.30	1.08

The B11-B16-1 link was considerably less favorable than the C4+B14 link. Segment B11 was dropped.

Comparison 29

C1+B8+B9 +B12-1+B12+ B13+B16-1	67.4	3167	47	1.20	
D5+C3+ C4+B14	52.0	2643	51		1.09

The shorter, more direct route over link D5-B14 was preferable in this comparison even though it has a greater average impact score per mile of length. From these various comparisons, the following segments were dropped from further analysis: B4-2, B5, B6, B7, B8, B9, B10, C1 and C2.

Comparison 30

B14+C-4+C3 +D5+D5-1+ B4-1+B3-1	100.5	5240	52	1.16	1.21
B16-1+B13+ B12+B12-1+ B12-2+A4-1+ A3+A2	103.9	4516	43		

This comparison of the two major links between the point just west of Helena to the least impact link north of Missoula favors the more southerly route via link B16-1 through A2. This link would have 16 percent less impact, even though it is slightly longer. It was retained to complete the Helena plan-of-service corridor.

Results of this analysis provide the following set of segments as the least impact corridor for the Helena plan-of-service:

B33, B31, B29, C12, C10, B22, B20, B16-1, B13, B12, B12-1, B12-2, A4-1, A3, A2, A1-2, B3, B2 and B1.

The B33, B31, B29 link would be best for all three plans-of-service and is retained for the Great Falls and Butte-Anaconda corridors. The Butte-Anaconda plan-of-service would have the same least impact corridor westward from where it intersects the Helena plan-of-service at segment A4-1. The other portions of a least impact corridor for the Great Falls and Butte-Anaconda plans-of-service were determined through comparative segment analysis, as detailed below.

Butte-Anaconda Plan-of-Service

		Impact Score		Score Difference (Larger÷Smaller)	
Segment(s)	Length(mi)	Total	Per Mile	Total	Per Mile
Comparison 31					
A6	69.7	2984	43		
A7	70.9	3043	43	1.02	1.00

The difference in total impact score between these two segments was too small to be considered conclusive. The impact per mile was identical. Therefore, the total was broken down into individual determinant scores. This breakdown revealed that 11 of 13 determinants favored segment A6; that is, the potential impact was less for this segment for 11 of the 13 determinants. Based on this, the decision was made to retain A6.

Comparison 32

B17+B19+ B24+B26+ B27	155.3	5742	37		
A5+A6+A8	172.5	7086	41	1.23	1.11

The difference in both the total impact score and impact per mile clearly indicated that the B17-B27 link was favorable over the A5-A8 link. To see why this difference occurred, the score was broken down among the individual determinants. The following list shows which link each determinant favored and the magnitude of difference:

Determinant	Favored	Score Difference (Larger÷Smaller)
Wildlife	"A"	1.12
Soils	"B"	1.03
Surface Water	"A"	1.14
Veg. Cover	"A"	1.06
Uniq. Nat. Res.	"B"	6.00
Agr. Land	"B"	1.69
Comm. For. Land	"A"	2.96
Rangeland	"B"	1.11
Recr. Use	"B"	1.39
Preh. & Hist.	"B"	1.25
Human Pop.	"B"	2.07
Visual Qual.	"B"	1.07
Visual Sens.	"B"	1.54

Nine determinants favored the "B" link and four favored the "A" link. The "B" link does cross a roadless area (part of segment B24), but it can be avoided during centerline location. These facts considered, the decision was to retain the B17-B27 link for this plan-of-service and delete segments A5, A6, and A8. From previous comparative analysis (Helena plan-of-service), segment B28 had been shown to be the best corridor to the junction of B27 and B28. Thus, the least impact corridor for the Butte-Anaconda plan-of-service is composed of the following segments:

B33, B31, B29, B28, B27, B26, B24, B19, B17, A4, A4-1, A3, A2, A1-2, B3, B2 and B1.

Great Falls Plan-of-Service

Segment(s)	Length(mi)	Impact Score Total	Impact Score Per Mile	Score Difference (Larger÷Smaller) Total	Score Difference (Larger÷Smaller) Per Mile
Comparison 33					
D12	91.0	3078	34	1.28	1.10
D10 + D13	77.9	2407	31		

The D10 + D13 link appeared to be of considerably lower potential impact as a result of less impact per mile and a considerably shorter length. A review of determinant scores revealed the following breakdown:

Determinant	Favored	Score Difference (Larger÷Smaller)
Wildlife	D12	1.30
Soils	D10+D13	1.06
Surface Water	D10+D13	1.08
Veg. Cover	D12	1.07
Unique Nat. Res.	(none)	-
Agr. Lands	D10+D13	4.55
Commer. For. Land	(none)	-
Rangeland	D10+D13	1.31
Recreation	D10+D13	1.04
Preh. & Hist.	D10+D13	1.16
Human Pop.	D10+D13	2.51
Visual Qual.	D12	1.13
Visual Sens.	D10+D13	1.76

Eight of 13 determinants favored the D10+D13 link, three favored the D12 segment, and there was no difference in the other two determinants. The decision was to retain the D10+D13 link and delete the D12 segment.

Comparison 34

D8 + D10	90.6	4150	46		1.07
D9 + D11	105.9	4574	43	1.10	

The D9 + D11 link is somewhat lower in average impact score per mile, but its much longer total length gives it a greater potential environmental impact (10%) than the shorter D8 + D10 link. The decision was based on the total impact, and D9 was deleted. Segment D11 was retained for further comparisons.

Comparison 35

D7+D8+D10	96.8	4534	47		1.02
C3+C4+C5 +C6+D11	119.2	5484	46	1.21	

There was very little difference in the average impact score per mile, but the shorter D7-D10 link had a 21 percent lower impact score. Segments C3, C4, C5, C6 and D11 were deleted from the Great Falls plan-of-service and segments D7, D8 and D10 were retained.

Previously (comparison 14, Helena plan-of-service) segment D6 was shown to have less total potential impact than D5+D7. Also, the segments running in a general north-south direction which connect segments D6 or D7 with the A2 or A3 segments were deleted due to unfavorable comparisons (Steps 26-29). However, to see if these decisions were valid in the case of delivering electricity from the north through the Great Falls plan-of-service, the following comparison was made, using some previously deleted segments:

Comparison 36

D6+D5-1+ B4-1+B3-1	58.6	3201	55		1.10
D7+C2+B7 +B5+B5-1+A2	69.8	3457	50	1.08	

The average impact score per mile was ten percent lower on the D7-A2 link, but due to its greater length, it scores eight percent worse in total impact potential. The decision was made to retain the D6-B3-1 link for this plan-of-service. At the junction of segment B3-1 with A1-2, the least impact route would follow the same as that already derived for the Helena plan-of-service. The D5-1 through B2 link had been shown to be of lower potential impact than the D4-D1 link (Comparison 21). The least impact corridor for the Great Falls plan-of-service is composed of the following set of segments:

B33, B31, B29, D15, D14, D13, D10, D8, D6, D5-1, B4-1, B3-1, A1-2, B3, B2 and B1.

CORRIDORS FOR STEP 2 ANALYSIS

These results were used for a corridor segment map showing: the least-impact corridors from Step 1 analysis; the Applicant's proposed corridor; and the Siegel Pass alternative around the Flathead Indian Reservation (see Figure V-1).

For Step 2, the combined Step 1 segments which are uninterrupted portions of each corridor were identified by letters. The relationship between the Step 1 segments and the Step 2 segments is summarized as follows:

Step 2 Corridor Segment		Step 1 Segments Comprising Step 2 Corridor Links
A	=	B29 + B31 + B33 24.6 21.3 65.5 = 111.4 miles
B	=	D6 + D8 + D10 + D13 + D14 + D15 10.1 41.1 49.5 28.4 76.7 36.0 = 241.8 miles
C	=	B20 + B22 + C10 + C12 40.2 25.6 31.0 77.7 = 174.5 miles
D	=	A4 + B17 + B19 + B24 + B26 + B27 + B28 10.7 39.2 8.8 58.1 21.3 27.9 50.3 = 216.3 miles
E	=	D5 + C3 + C4 + B14 4.9 26.3 12.2 8.6 = 52.0 miles
F	=	B12-2 + B12-1 + B12 + B13 + B16-1 19.6 5.2 5.1 9.8 3.0 = 42.7 miles
G	=	D1 + D3 + D4 19.7 14.8 43.8 = 78.3 miles
H	=	B3-1 + B4-1 + D5-1 17.8 3.9 26.8 = 48.5 miles
I	=	A2 + A3 + A4-1 32.0 25.8 3.4 = 61.2 miles
J	=	A1-2 4.7 miles
K	=	B2 + B3 15.9 19.8 = 35.7 miles
L	=	B1 16.1 miles
M	=	A1 57.2 miles

The corridors for Step 2 analysis are as follows:

Corridor	Link	Miles
Applicant's Proposed	A - C - E - G - L	432.3
Siegel Pass	A - C - E - H - J - M	448.3
Helena	A - C - F - I - J - K - L	446.3
Great Falls	A - B - H - J - K - L	458.2
Butte-Anaconda	A - D - I - J - K - L	445.4

CORRIDOR ANALYSIS AND EVALUATION

(STEP 2)

CORRIDOR ANALYSIS AND EVALUATION
(STEP 2)

OBJECTIVES

1. Conduct an environmental analysis on the corridors identified in Step 1.
2. Compare the corridors through adaptation of Step 1 methodology.

CORRIDORS TO BE STUDIED AND LEVEL OF ANALYSIS

Step 1 identified the combinations of segments (from among the large network of initial segments shown in Figure IV-3) which would provide the least-impact corridor for each of the three plans-of-service. In Step 2, these corridors--Great Falls, Helena, and Butte-Anaconda along with the Applicant's proposed corridor and its alternative around the Flathead Indian Reservation (the Siegel Pass alternative)--were then analyzed and evaluated in more depth to determine the potential environmental impacts for each corridor.

The original segments which could have served as viable alternatives (based on system requirements) in the Great Falls, Helena, or Butte-Anaconda plans-of-service are shown in Figure IV-2. The least-impact segments from Step 1 are presented in Figure V-1 as the five alternative corridors analyzed in Step 2. Each uninterrupted portion of each Step 2 corridor was labeled with a letter, from A to M, to simplify identification and to prevent confusion with the numbered segments of Step 1.

Step 2 corridor analysis and evaluation was considerably more rigorous and detailed than was the segment analysis and evaluation of Step 1. Approximately 45% of the original highest impact segments were eliminated in Step 1 based on available data and information. The remaining corridors were then studied in more detail. Some of the available data were developed to a greater extent to show more clearly their relationship to potential impacts. Also, supplemental information deemed necessary for a complete analysis was developed for certain resources. Aerial survey and reconnaissance of each Step 2 corridor by both airplane and helicopter allowed adequate development of resource data bases and verification of certain other information sources.

The Step 2 analysis and evaluation was conducted on 2-mile wide corridors. The influence zones for visual and recreation considerations extended up to six miles on either side of the center of this 2-mile wide corridor. Potential impacts were recorded where sensitive areas or resource items occurred within the 2-mile wide corridor. Judicious centerline location within the 2-mile corridor and careful tower siting could reduce or eliminate some of these impacts. Specific changes in methodology, data items, and determinants made for this phase of the analysis are described in detail in this chapter.

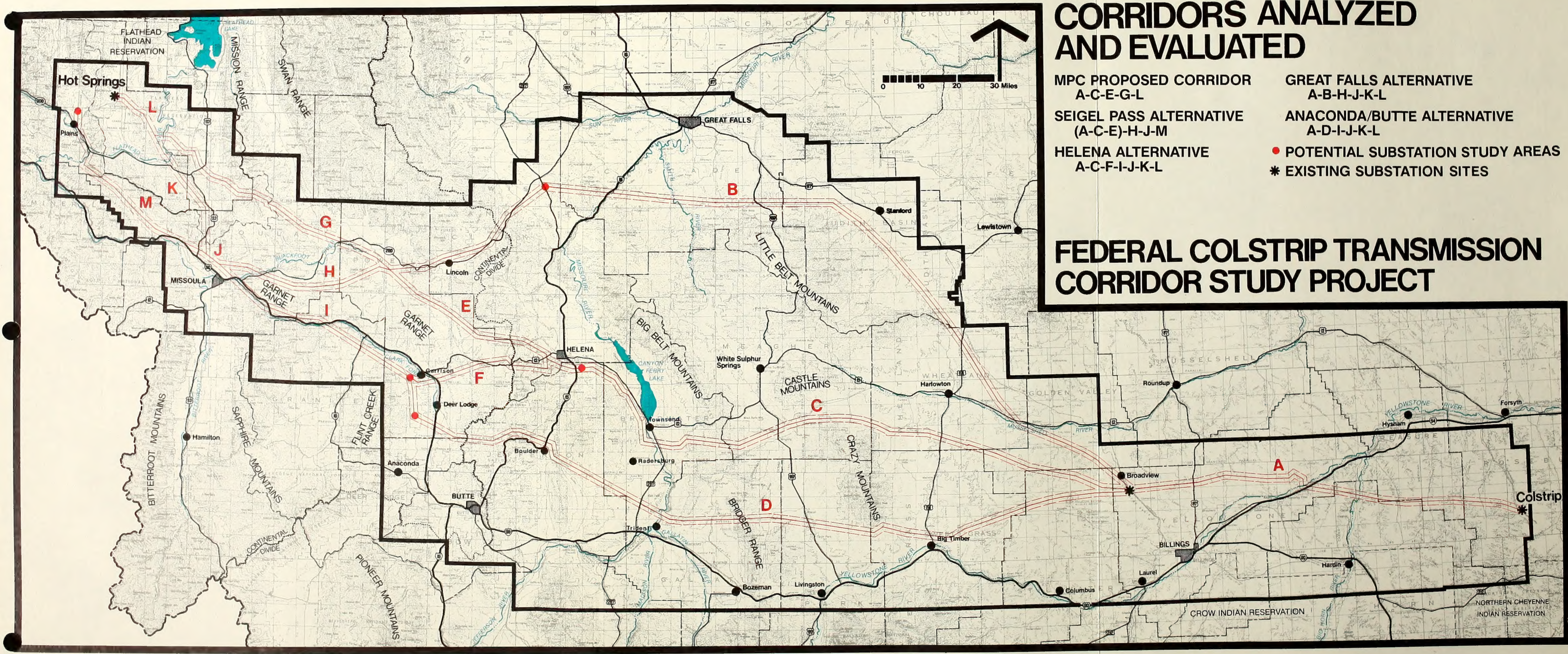
PROCEDURE

METHODOLOGY

Introduction

The method for deriving a number value for each corridor segment to reflect the potential impact of introducing transmission facilities is discussed in Chapter IV. This method was also used in Step 2 to derive corridor impact scores. The major difference between Step 1 and Step 2 is that certain data items were refined by incorporating more and/or better information. Figure V-2 displays the relationship between determinants and data items employed for Step 2 analysis. Comparing this with Figure IV-4, which shows the relationship between Step 1 determinants and data items, provides an indication of these differences. Effects of these differences are discussed under "Description of Determinants and Data Items" in this chapter.

Resource maps used for rating each determinant were based on the refined resource data. Impact scores developed from Step 2 maps by applying



CORRIDORS ANALYZED AND EVALUATED

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure V-1

Data Item Weights - H=4, M=2, L=1

RESOURCE DATA ITEMS

DETERMINANTS	WEIGHTS	LAND SUITABILITY	Good	Fair	Poor	SURFACE WATER	Sediment Risk - High	Sediment Risk - Medium	Sediment Risk - Low	FISH AND WILDLIFE	High Impact Potential	Medium Impact Potential	Low Impact Potential	Threatened and Endangered Animal Species	VEGETATION	Agriculture	Irrigated Land	Prime and Unique Farm Land	Dry Land Farming	Rangeland	Intermtn. Valley Grassland and Meadow	Foothill Sagebrush	Foothill Grassland	Northern Grassland	Teton River-Judith Basin Grassland	Central Grassland	Beartooth Juniper/Limber Pine	Riparian	Sandy Grassland	Forest Land	Larch/Douglas-fir	Lodgepole Pine/Douglas-fir	Western Montana Ponderosa Pine	Eastern Montana Ponderosa Pine	Ponderosa Pine Savannah	Wetlands	Threatened and Endangered Plant Species	SPECIALLY MANAGED AREAS	Wilderness/Primitive	New Wilderness Study Areas	Roadless Areas (Includeds Essentially Roadless)	Natural Areas (Pristine, Relict, Geologic, Scenic & Landmarks)	Game Refuges and Ranges	State Parks and Recreation Areas	Wild and Scenic Rivers	Scenic Travelways	Recreation Waterways	Management Objectives for Specified Areas	RECREATION SUITABILITY	High Impact Potential	Medium Impact Potential	Low Impact Potential	PREHISTORIC AND HISTORIC	High Sensitivity Zone	Medium Sensitivity Zone	Low Sensitivity Zone	VISUAL	Scenic Quality	Distinctive	Common	Minimal	Visual Contrast	High	Medium	Low	Visual Management Classes	Preservation	Retention	Partial Retention	Modification	Maximum Modification	POPULATION DENSITY AND PROXIMITY	<49 Persons Per Square Mile	5 – 49 Persons Per Square Mile	>5 Persons Per Square Mile	Pop. Ctr. Crossed by or within 1 Mi. of Corr.
FISH AND WILDLIFE	2										H	M	L	H																						H							H																																		
LAND SUITABILITY	2		L	M	H																																																																								
SURFACE WATER	1						H	M	L																											H																																								
VEGETATIVE COVER	2																L	L	L		M	M	M	M	M	M	M	M	M		H	H	H	H	H	H	H																																							
UNIQUE NATURAL RESOURCES	3																																			H	H		H	H	L	H		M	H																															
AGRICULTURAL LAND	2																H	H	M																																																									
COMMERCIAL FOREST LAND	3																														H	M	H	M	L																																									
RANGELAND	1																				L	M	L	L	M	L	M	L	M		L	L	H	H	M	H																																								
RECREATION RESOURCES	2										M	L																								M			H	H	H	H	H	H	H	H	H			H	M	L							H	M	L																
LAND MANAGEMENT PLANS	–																																						■	■	■	■	■	■	■	■	■	■																													
PREHISTORIC & HISTORIC	2																																																					H	M	L																							
HUMAN POPULATION	2																																																																										H	M	L	H
VISUAL RESOURCES	3																																																														H	M	L		H	H	M	L	L					

CORRIDOR ANALYSIS AND EVALUATION MATRIX
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure V-2

Step 1 methodology are considered to be reliable estimates of potential impacts. An impact score was derived for each corridor segment through this approach. Total corridor impact scores are the sums of impact scores for each of the segments composing a corridor. Direct comparisons of corridor impact scores allowed evaluation of relative impacts from each corridor. These comparisons were based on the Applicant's proposed corridor.

Adjustments for Paralleling Existing Powerlines

An additional adjustment of impact scores was made in Step 2 to account for the existence of powerlines along portions of certain corridor segments (see Figure III-20 for the distribution of existing rights-of-way in the study area). This was entered into the analysis as an additional determinant referred to as the Parallel Advantage Determinant. This adjustment was made to account for the generally lower impacts resulting from paralleling existing rights-of-way as opposed to crossing environments not interrupted by power lines.

The Parallel Advantage determinant is composed of six data items, each consisting of a power line of a given size and whether forested or unforested land is crossed by the line (Table V-1). Each of these data items was evaluated for the advantage (reduction of impact potential) it represents to the various resource determinants of Step 2. Resources in only 9 of the 13 determinants were thought to benefit significantly from paralleling an existing line, so not all determinants are represented in this table. The advantage of paralleling existing power lines was rated as 1 (slightly advantageous), 2 (moderately advantageous), or 4 (highly advantageous) for each of the resource determinants.

The visual resource adjustments, from Table V-1, can be used to illustrate the assignment of values for different levels of advantage. In forested areas, corridor clearing creates most of the visual contrasts. Within the study area, 90 feet is the average clearing width for existing lines smaller than 230-kV. The average for 230-kV lines is 125 feet. The

Table V-1 - THE "PARALLEL ADVANTAGE" DETERMINANT

	Existing Corridors Paralleled (Data Items) 3/					
	Forested			Nonforested		
Determinant 1/	230kV	230kV	230kV+ 2/	230kV	230kV	230kV+ 2/
Fish and Wildlife (2)	2 (4)	2 (4)	4 (8)	1 (2)	1 (2)	1 (2)
Land Suitability (2)	2 (4)	2 (4)	2 (4)	2 (4)	2 (4)	2 (4)
Surface Water (1)	2 (2)	2 (2)	2 (2)	1 (1)	1 (1)	1 (1)
Vegetation Cover (2)	1 (2)	1 (2)	1 (2)	-	-	-
Commercial Forest Land (3)	1 (3)	2 (6)	4 (12)	-	-	-
Rangeland (1)	-	-	-	1 (1)	1 (1)	1 (1)
Recreation Resources (2)	1 (2)	2 (4)	4 (8)	1 (2)	2 (4)	4 (8)
Prehistoric and Historic (2)	1 (2)	2 (4)	4 (8)	1 (2)	2 (4)	4 (8)
Visual Resources (3)	1 (3)	1 (3)	2 (6)	2 (6)	4 (12)	4 (12)
	(22)	(29)	(50)	(18)	(28)	(36)
Weighted	2.8	3.6	6.2	2.6	4.0	5.1

1/ - Includes only determinants that would benefit by paralleling existing rights-of-way. Determinant weights are in parenthesis.

2/ - 230kV+ = one 230kV line plus 1 or more smaller lines.

3/ - Left column shows Data Item Value: 1-slightly advantageous, 2-moderately advantageous, or 4-highly advantageous. Right column (in parenthesis) shows weighted ratings: Determinant Value X Data Item Value.

proposed corridor would have 300 feet of clearing. Compared to routing through an area without existing transmission lines, slight visual advantages would result from paralleling a single 90' or 125' corridor. Thus the "forested <230 and 230 columns" for Visual Resources on Table V-1 show ratings of 1. Where multiple corridors already traverse forested areas, moderate advantages would result from paralleling them; the visual impacts would be less than for initial corridors but, because the proposed corridor would be much wider than existing corridors, additional visual impacts from paralleling would still be significant. Thus the "forested 230+ column" on the table shows a rating of 2.

On agricultural lands and shrubby rangelands (i.e., all nonforested lands), towers create most of the visual contrasts. Within the study area, existing towers for lines smaller than 230-kV are usually made of wood and are 50-60 feet tall; 230-kV towers are either 60-70 feet high wood or about 90 feet tall steel lattice structures. The proposed towers would be steel lattice structures 140 feet tall. Because existing structures may already be skylined, paralleling existing 50-60 foot towers would be moderately advantageous, resulting in a rating of 2 for the Visual Resources "nonforested <230 column." Paralleling a steel 140-150 foot tower or multiple towers would be highly advantageous visually, especially compared to crossing pristine areas; thus Visual Resources "nonforested 230 and 230+" columns show a rating of 4.

This adjustment process assumes that the greater the visual impact of existing transmission lines, the smaller the added impact of new lines. If there were already a number of lines in a setting, however, adding new lines might make a bad situation intolerable. However, three existing parallel lines is the highest concentration of lines encountered within the study area. Thus the above assumption seems reasonable for this study.

Ratings for all affected resources were multiplied by the determinant value to obtain a weighted rating for each determinant. The sums of all weighted ratings for all determinants were divided by the number of determinants involved to yield mean weighted data item values. These values are given in the bottom line of Table V-1.

To adjust impact scores, each mean weighted data item value was multiplied by the number of miles of that type of line paralleled along each of the Step 2 corridors (see Figure V-3). Each resultant data item score was summed for all line types to provide a determinant score. The determinant score for each corridor was subtracted from the total score for that corridor, yielding reduced corridor impact scores which reflect the influence of parallel existing lines.

The following equations summarize the above process:

1. [Data Item Value] x [Determinant Value] = Weighted Determinant Value

2. $\begin{bmatrix}\text{Sum of Weighted}\\ \text{Determinant Values}\end{bmatrix} \div \begin{bmatrix}\text{Number of}\\ \text{Determinants}\end{bmatrix} = \text{Mean Weighted Data Item Value}$

3. $\begin{bmatrix}\text{Mean Weighted Data}\\ \text{Item Value}\end{bmatrix} \times \begin{bmatrix}\text{Miles of Line of}\\ \text{Each Data Item Type}\end{bmatrix} = \begin{bmatrix}\text{Data Item Score for}\\ \text{that Line Type}\end{bmatrix}$

4. $\begin{bmatrix}\text{Sum of all Data Item}\\ \text{Scores Across All Line Types}\end{bmatrix} = \text{Determinant Score for Parallel Advantage}$

5. $[\text{Total Impact Score}] - \begin{bmatrix}\text{Determinant Score for}\\ \text{Parallel Advantage}\end{bmatrix} = \begin{bmatrix}\text{Adjusted Impact}\\ \text{Score}\end{bmatrix}$

Data item scores and Parallel Advantage determinant scores for each segment are presented in Table V-2. Tables of impact scores in the "Results" section of this chapter are shown both with and without adjustments for this determinant. The adjustments range from 3 to 9 percent of the total unadjusted scores. Greater weight for Parallel Advantage would be justified if the existing lines were larger. However, two 500-kV transmission lines would represent an overwhelming effect compared to that of any of the existing lines. Furthermore, the extent of right-of-way clearing and access road construction required would partially obviate the advantage of paralleling existing corridors.

BENEFITS FROM PARALLELING EXISTING POWERLINES

🟥 High
🟩 Medium
🟨 Low
— None

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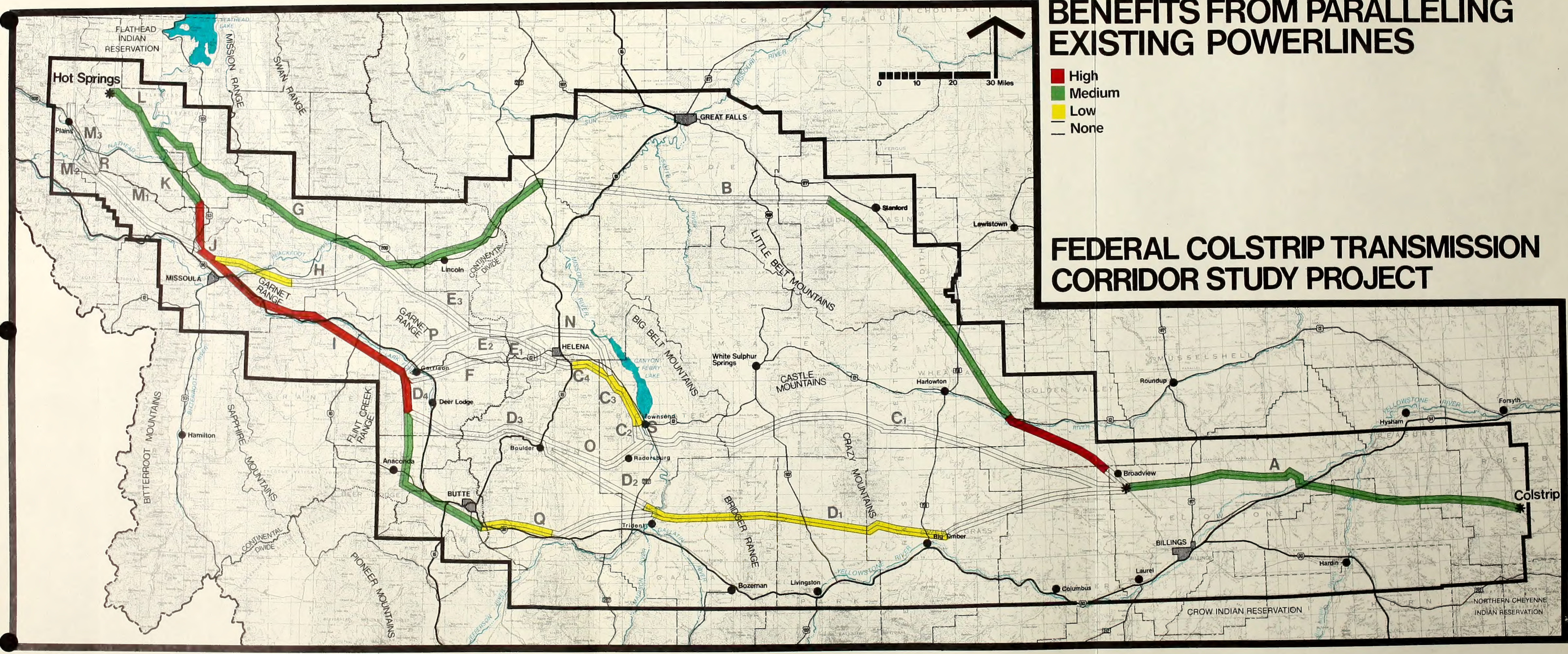


Figure V-3

Table V-2 - ADJUSTMENT FOR PARALLELING EXISTING POWERLINES (STEP 2)

CORRIDOR SEGMENT	LENGTH (in miles)	FOREST			NONFOREST			TOTAL ADJUSTMENT
		LESS THAN 230 kV (x2.8)*	230 kV (x3.6)*	MORE THAN 230 kV (x6.2)*	LESS THAN 230 kV (x2.6)*	230 kV (x4.0)*	MORE THAN 230 kV (x5.1)*	
A	111.4	-	16.3/-59	-	-	95.1/-380	-	-439
B	241.4	-	34.1/-123	-	-	93.9/-376	32.0/-163	-662
C	174.5	-	-	-	27.0/-70	-	-	- 70
D	216.3	6.0/-17	-	-	73.0/-189	-	10.7/-54	-260
E	52.0	-	-	-	-	-	-	0
F	72.7	-	-	-	-	-	-	0
G	78.3	-	44.3/-159	-	-	34.0/-136	-	-295
H	48.5	19.0/-53	-	-	-	-	-	- 53
I	61.2	-	-	10.4/-64	-	-	50.8/-259	-323
J	4.7	-	-	1.1/-7	-	-	3.6/-18	- 25
K	35.7	-	0.8/-3	8.3/-51	-	22.9/-92	3.7/-19	-165
L	16.1	-	-	-	-	16.1/-64	-	- 64
M	57.2	-	-	-	-	-	-	0

* This Parallel Advantage weight is multiplied by the number of miles (first number) to give the score adjustment value (second number) (see Table V-1).

DESCRIPTION OF DETERMINANTS AND DATA ITEMS

Fish and Wildlife

This determinant and the associated data items, as discussed in Chapter IV, were not changed for Step 2.

Land Suitability

This determinant and the associated data items, as discussed in Chapter IV, were not changed for Step 2.

Surface Water

This determinant and the associated data items, as discussed in Chapter IV, were not changed for Step 2.

Vegetative Cover

This determinant and the associated data items were not changed for Step 2. Consequently, the same data items were used in Step 2. Different data items terms for Step 2 are discussed under "Rangeland" in this chapter. The forest land data items were also expanded in Step 2, as explained under "Commercial Forest Land" in this chapter.

Unique Natural Resources

This determinant, as discussed in Chapter IV, was not changed for Step 2.

Agricultural Land

This determinant and the associated data items, as discussed in Chapter IV, were not changed for Step 2. However, the map of agricultural land used to measure distance each segment crossed either irrigated or dryland fields was refined during Step 2. Aerial reconnaissance allowed the identification of certain farmed areas which were not distinct on the satellite imagery or which had recently been converted to farm land.

Commercial Forest Land

Definitions

The definitions found under the "Commerical Forest Land" discussion for Step 1 (Chapter IV) also apply to this step.

Development and Maps

The data items comprising forest land have been redefined from Step 1 in order to better correlate the data item components and their productivity. Interpretations made for rangeland occurring on forested lands are also consistent with these new data items as the same typing classifications were made for both resources.

Data items are described under "Principal Vegetation Types" (Chapter III). Productivity is measured as growth in cubic feet per acre per year, based on National Forest averages. These averages are good only for comparing corridors or segments of corridors because they represent combinations of species, age classes, and stocking levels within each forest type. The growth rate potentials are also based on the assumption that some form of timber management, such as stocking control, is being applied to the stands.

The map is taken from the publication "Vegetative Rangeland Types in Montana" (MSU 1973). In addition to this publication, interpretive data are from Chaffee (1973) and the USDA Forest Service.

Habitat typing, or classifying forest land according to its potential climax vegetative community, is not available for most of the forested land so it could not be used for assessing the potential productivity of the forested lands.

Composition and Data Item Values

As in Step 1, this determinant considers only those areas of forest land defined as commercial forest land, including the western larch/Douglas fir, lodgepole pine/Douglas fir, western and eastern Montana ponderosa pine, and the ponderosa pine savannah types.

The greatest impact on timber stands from the introduction of a transmission line would occur in the most highly productive forest types, such as the western larch/Douglas fir and the western Montana ponderosa pine types. The lodgepole pine/Douglas fir and eastern Montana pondersoa pine types are rated moderately productive and have a medium impact potential. The ponderosa pine savannah, with its wider spacing of trees and low volumes per acre, would receive a low impact from clearing for a transmission line.

Determinant Value

The determinant value of 3 (high) has not been changed from Step 1.

Rangeland

This determinant and the associated data items were not changed between Step 1 and Step 2. The only difference between the Step 1 and Step 2 matrices involved the use of data item terms (see Figures IV-4 and V-2, respectively). The Step 1 matrix uses the terms "good productivity/poor recoverability," "fair productivity/fair recoverability," and "poor productivity/good recoverability" for data items, in lieu of listing all the vegetation types (data items) in Figure IV-4. Vegetation types were listed directly as data items in the Step 2 matrix (Figure V-2) because this matrix is somewhat less detailed than the Step 1 matrix. This information is described in Chapter IV.

Recreation Resources

Definitions

The methodology for rating recreation resource impacts was changed considerably for Step 2. A change was considered necessary because a more refined information base had been developed to allow a more systematic evaluation of potential impacts on recreation resources.

The Recreation Suitability Evaluation for Step 2 was an inventory of recreation resource values that could be impacted by the proposed Colstrip transmission facilities. The evaluation consisted of the following steps:

1. Selection of recreation land units for all areas crossed by the proposed or alternative corridors - The recreation land units were chosen from the mapping units used on the USDA Forest Service land suitability map (USDA Forest Service 1976a), Figure III-6. It was assumed that land areas with similar characteristics would manifest similar recreation use patterns and similar recreational opportunities, especially regarding dispersed recreation use;

2. Development of a recreation resource value "score" for each recreation land unit - A recreation suitability evaluation form was used to generate a recreation resource value score for each recreation land unit. The form is displayed and explained in Appendix A-3;

3. Categorizing recreation resource value "scores" into high, medium or low impact ratings - Recreation land unit scores were plotted on a graph. The resultant two curves separate the recreation land unit scores into high, medium or low impact ratings (see Figure V-4);

Development and Maps

Resultant impact ratings were plotted on a 1:500,000 map overlay.

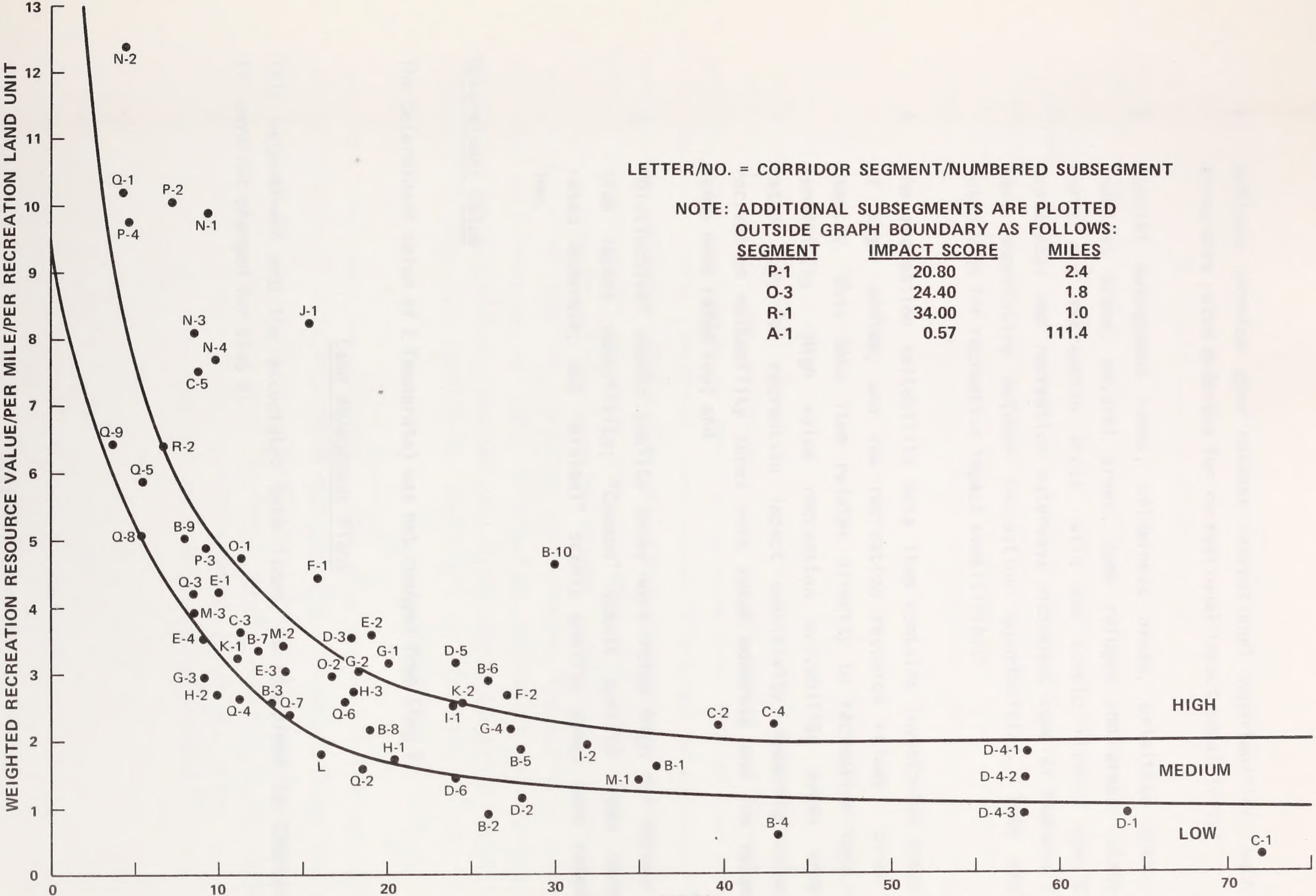
Composition and Value of Data Items

Potential impacts on recreation resources resulting from the construction, operation, and maintenance of twin 500-kV lines were determined by combining the following resource data items:

1. Fish and Wildlife
2. Wetlands
3. Wilderness Areas
4. Primitive Areas
5. Roadless Areas
6. Natural Areas
7. Game Refuges and Areas
8. State Parks and Recreation Areas
9. Wild and Scenic Rivers
10. Scenic Travelways
11. Recreation Waterways
12 Recreation Suitability
13. Scenic Quality

The above resource data items were rated as follows:

1. Because fishing and hunting are not the top recreation activities by frequency of participation in Montana (4th and 8th, respectively), the more highly valued fish and wildlife resource areas were rated moderate for recreation impact sensitivity and the moderate fish and wildlife resource values were rated low for recreation impact sensitivity. Low valued wildlife resources were not rated.



LETTER/NO. = CORRIDOR SEGMENT/NUMBERED SUBSEGMENT

NOTE: ADDITIONAL SUBSEGMENTS ARE PLOTTED OUTSIDE GRAPH BOUNDARY AS FOLLOWS:

SEGMENT	IMPACT SCORE	MILES
P-1	20.80	2.4
O-3	24.40	1.8
R-1	34.00	1.0
A-1	0.57	111.4

RECREATION LAND UNIT RATING CURVE
Figure V-4

2. Wetlands provide good outdoor recreational opportunities; such areas were rated moderate for recreational impact sensitivity;

3. Special management zones, wilderness areas, primitive areas, roadless areas, natural areas, game refuges and areas, state parks and recreation areas, wild and scenic rivers, scenic travelways and recreation waterways encompass some of Montana's most superlative outdoor recreation opportunities. Each was rated high for recreation impact sensitivity;

4. The recreation suitability data item contains inventoried areas of high, medium, and low recreation resource values. Consequently, this data item relates directly to recreation impact sensitivity. High value recreation suitability areas were rated high for recreation impact sensitivity, moderate value recreation suitability zones were rated moderate and low value zones were rated low; and

5. "Distinctive" scenic quality zones were rated high for recreation impact sensitivity; "Common" scenic quality areas were rated moderate; and "minimal" scenic quality zones were rated low.

Determinant Value

The determinant value of 2 (moderate) was not changed from Step 1.

Land Management Plans

This determinant and the associated data items, as described in Chapter IV, were not changed for Step 2.

Prehistoric and Historic

Discussion

In Step 1, the analysis of prehistoric data items was based on the limited amount of information compiled at that time. However, additional information from the Forest Service, Bureau of Land Management, National Park Service and the State of Montana about the location of prehistoric and historic sites made possible a more accurate assessment of potential impacts in Step 2. A number of other changes were also made to enhance the evaluation.

Development and Maps

Each known prehistoric site within 2 miles of either side of the center of a corridor segment was carefully mapped for evaluation. Prehistoric sites outside this area would probably not be encountered in the process of constructing the transmission lines. Therefore, these sites were not considered. As suggested by Montana authorities (Sharrock 1977; Martin 1977), prehistoric data items were not ranked but rather were considered equal in value. In Step 1, concern had been shown for potential prehistoric sites, or sites yet undiscovered. Although the need for assessing the potential for disturbing undiscovered sites during centerline location is still recognized, there is no reasonable way to make such an assessment for all the corridors in this study. Therefore, only known prehistoric sites were used for Step 2.

Prehistoric and historic data were plotted on the same map. From the visual resource analysis, it had been determined that the primary visual influence zone would extend a maximum of 6 miles on either side of the center of a corridor. Since historic sites are usually inherent parts of the visual landscape, those within the above 6 mile visual zone were mapped for the corridor evaluation. National Register sites were included.

The final map included both prehistoric and historic sites. Each mile of corridor segment along which two or more sites occur was rated high (4), to reflect a higher density of sites. Where there is one site along a mile of corridor segment, a medium value (2) was assigned. Each mile of segment along which there are no existing sites was rated low (1). Thus, a long corridor segment might have a higher value owing entirely to its length. Nevertheless this approach was considered to be consistent with that used for the evaluation of other resources.

Composition and Value of Data Items

In Step 2, National Register sites were no longer considered separately. All prehistoric and historic sites were plotted on the same map and given equal value. However, high, medium, and low values were still assigned based on the density of sites as previously explained.

Determinant Value

Prehistoric and historic resources retain the same value of 2 (medium) as used in Step 1.

Human Population

This determinant and the associated data items, as described in Chapter IV, were not changed for Step 2.

Visual Resources

Step 2 visual data items differ from those used in Step 1. The Study Team found the available visual information inadequate; consequently, a consultant was retained, primary data collected, and the following more comprehensive methodology used.

Definitions

Visual Resources - This term acknowledges that land, water, vegetative, and other landscape features have visual and aesthetic qualities that have become increasingly important to the American public.

Visual Resource Management Classes - These categories define acceptable limits to the visibility of projects in the landscape. Lands of similar visual and aesthetic value are placed in the same class. These classes are:

Class I - Preservation - This class applies to recognized wilderness areas, primitive areas, roadless areas, and proposed wilderness areas. Only natural ecological changes are acceptable;

Class II - Retention - Retention lands are those lands of outstanding or distinctive quality that are seen from roads or areas which are often used or which support activities requiring natural settings. Only management activities or projects that are not visually evident are acceptable. Contrasts created in the construction of a project should be reduced to this level either during or immediately after construction. "This may be done by such means as seeding vegetative clearings and cut-or-fill slopes, hand planting of large stock, painting structures, etc." (USDA Forest Service 1974c:30);

Class III - Partial Retention - Partial Retention lands are lands of high quality-low sensitivity or low quality-high sensitivity. To be acceptable, management activities and projects must be visually subordinant to the characteristic landscape. When seen from a distance, project-related contrasts may not dominate the view. "Reduction of contrasts to meet this objective should be accomplished as soon after project completion as possible or at a minimum within the first year" (USDA Forest Service 1974c:32).

Class IV - Modification - Modification lands are lands of minimal quality that are seldom seen or seen only from areas of secondary importance. Management activities may visually dominate the characteristic landscape, but must appear to be a natural occurrence. Reduction of contrasts to meet this requirement should be accomplished within a year after construction; and

Class V - Maximum Modification - Maximum Modification lands are lands are lands of relatively low scenic quality and visual sensitivity. Management activities may dominate the characteristic landscape, but, when viewed as background, "the visual characteristics must be those of natural occurrences within the surrounding area or character type" (USDA Forest Service 1974c:36). BLM uses Class V as an interim management class for areas requiring rehabilitation or enhancement. Reduction of contrasts to acceptable levels should be complete within 5 years.

Visual Contrast Rating - This is a method for determining how visible a proposed activity would be in a particular landscape. Visual contrast is rated as high, medium, or low, as follows:

High Contrast Zones - These land areas are characterized by: a low-vegetative cover density; shallow, light colored soils; steep to very steep slopes; minimal landscape variety (monotonous landscape character); and a low regenerative capability. Where this type of landscape character with its low-screening potential occurs in close proximity to major use areas, a high contrast situation exists. Some land areas, however, that may have a higher density vegetative cover and a good soil productivity may also be mapped as having a high contrast potential if other high contrast factors such as steep slopes, light colored soils, and close proximity to high use areas are present.

In high contrast zones, project impacts would be highly visible for approximately 3 to 5 miles. Conspicuous corridors and skylined towers would probably result from locating transmission lines in these areas.

Medium Contrast Zones - These are land areas characterized by: medium density vegetation; fair to good productivity; and a moderate level of landscape variety that offers fair to good screening potential for the transmission line and its supporting facilities. Some lands with high contrast characteristics (low density vegetative cover, less productive soils, and steep terrain) may be mapped as having a moderate contrast potential should they occur in seldom seen areas. Some lands with low contrast characteristics (high absorptive capability) may also be mapped as having a moderate contrast potential should they be within view of high density use areas.

In medium contract areas, project impacts would be highly visible for 1.5 to 3.5 miles. Towers would often be skylined and corridors minimally to moderately defined. Although medium contrasts are common, they are visually quite significant.

Low Contrast Zones - These lands are characterized by a high degree of absorptive capability. They have a high level of landscape variety, good to excellent vegetative cover, productive soils, soil colors that blend with vegetative colors, a high regenerative capability, and a broken or rolling land form that offers many opportunities to screen transmission facilities. Even though these areas may be near major seen travelways, highways, waterways, or high density use areas, the combined landscape character tends to "absorb" the project impacts.

In low contrast areas, project impacts would be highly visible for 1 to 1.5 miles. Low contrasts occur only where rights-of-way could blend imperceptibly with the surrounding area and where towers would likely to backdropped. Towers in these areas would be prominent seen from nearby and difficult, perhaps impossible, to screen; however, project impacts would be visually important only for short distances.

Development and Maps

Visual resources information was developed and mapped based on concepts and procedures presented in National Forest Landscape Management: The Visual Management System (USDA Forest Service 1974c), and BLM Manuals 6300, 6310, and 6320. The following discussion summarizes information from the Colstrip to Hot Springs Visual Resource Analysis (Wirth 1977) and Appendix A-4, which contains descriptions of information development and mapping procedures. Analysis of visual impacts was based on the interaction of the two data items discussed below - visual resource management classes and contrast rating.

Visual Resource Management Classes - Land within the study area was classified into five visual resource management classes (Preservation; Retention; Partial Retention; Modification; or Maximum Modification) according to the following three factors:

1. Inherent scenic quality of the landscape;
2. Visual sensitivity of the area's viewers; and
3. Distance from land uses.

These factors were analyzed and visual management units identified through the following process:

1. Defining and mapping scenic quality classes;
2. Determining the visual sensitivity associated with land uses;
3. Mapping viewed areas and distance zones.

Based on the above, management classes were assigned and mapped, as shown on Figure V-5, the "Visual Resources Management Classes" map.

Visual Contrast Rating - The visual contrast data item was based on the BLM system (BLM Manual 6320). Briefly, the system is based on the premise that the severity of adverse impacts depends on the degree of visual contrast between an activity and the landscape. Degrees of contrast are predicted by considering landscape features (i.e., landforms, vegetation, structures) separately. Each feature is broken down into its basic elements (i.e., form, line, color, texture). Based on relative visual importance, contrasts in form were assigned a weight of 4; line, 3; color, 2; and texture, 1. The strength of contrasts that would be caused in each element was evaluated by assigning a multiplicative value of 3 for strong contrasts, 2 for moderate contrasts, 1 for weak contrasts, and 0 for no contrasts. Multiplying the element weight by the contrast strength value gave a score for each element. Element scores were then summed to provide a contrast score for each feature. Finally, the scores for landform, vegetation and structure features were added for each area. The totals indicate the overall severity of visual impacts. For analysis purposes, the total contrast scores were grouped into high, medium, and low overall contrast categories. Areas in each category were then mapped, as shown in Figure V-6, the "Visual Contrast Rating" map.

Composition and Value of Data Items

Step 1 included two separate visual determinants, Scenic Quality and Visual Sensitivity. In Step 2, these considerations and others were combined into a single Visual Resources determinant, which is based on the interaction of two data items: visual resources management classes and visual contrast ratings. Visual resources management classes are based on the (a) aesthetic quality of the land; (b) sensitivity of viewers; and (c) distance from viewers. The contrast rating evaluates the visibility of two 500-kV transmission lines in different landscapes. Every mile of the proposed and alternative corridors was placed into a management class and given a contrast rating.

To express the visual impacts in a form consistent with that for other impacts, high, medium, and low values were assigned based on the interaction between the two data items, as shown in Table V-3. For example, a "medium" contrast rating combined with a "retention" management class yields a "high" visual impact value.

VISUAL RESOURCE MANAGEMENT CLASSES

- ☐ Preservation
- ☐ Retention
- ☐ Partial Retention
- ☐ Modification
- ☐ Maximum Modification

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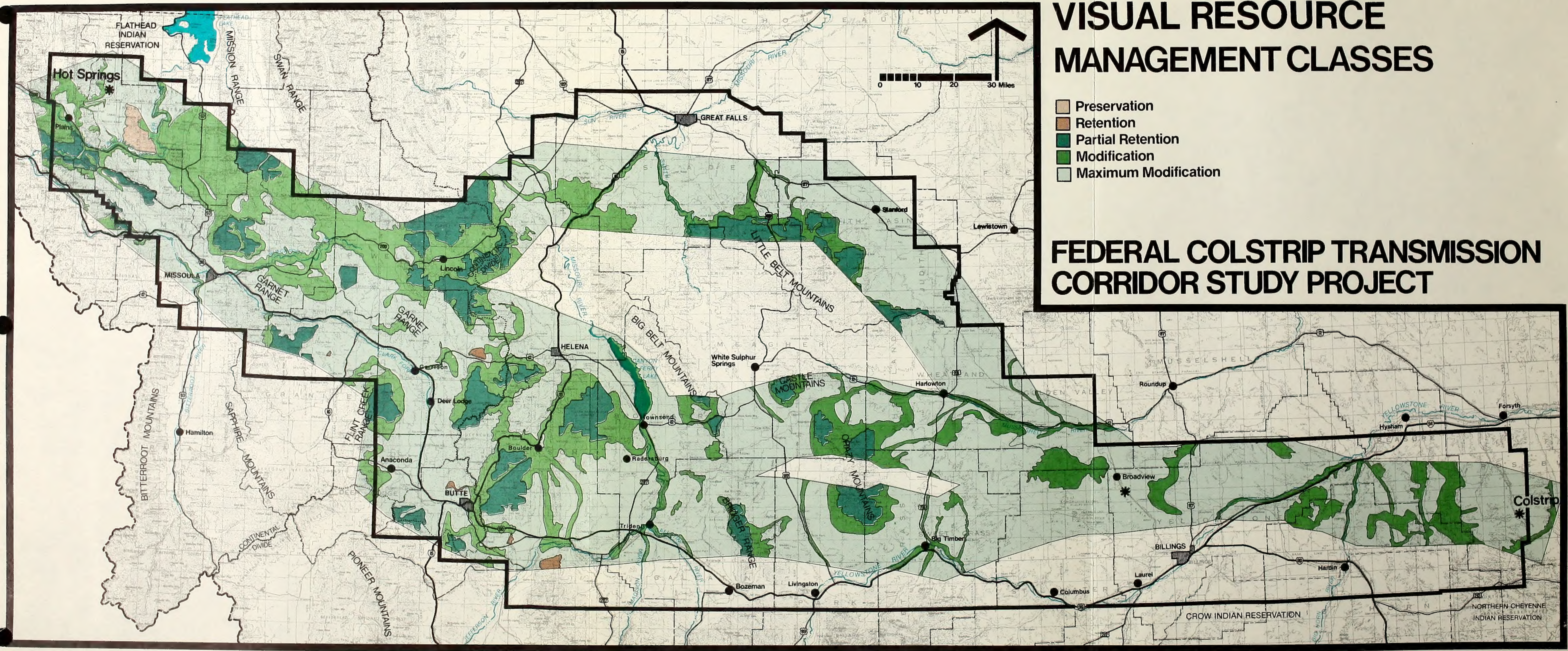


Figure V-5

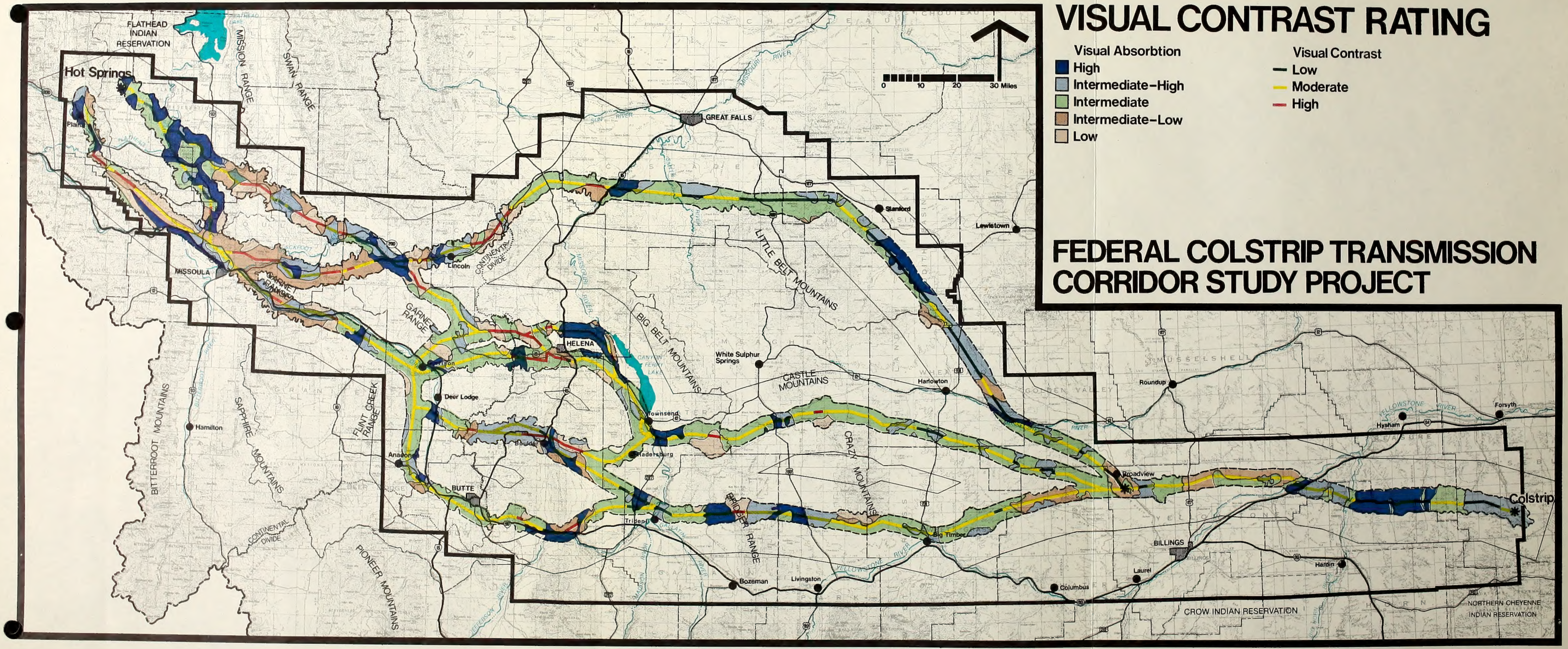

VISUAL CONTRAST RATING
Visual Absorbtion
🟦 High
▨ Intermediate-High
🟩 Intermediate
▨ Intermediate-Low
☐ Low
Visual Contrast
— Low
— Moderate
— High
0 10 20 30 Miles
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
FLATHEAD INDIAN RESERVATION
FLATHEAD LAKE
MISSION RANGE
SWAN RANGE
Hot Springs
Plains
MISSOULA
GARNET RANGE
Lincoln
CONTINENTAL DIVIDE
GREAT FALLS
SUN RIVER
MISSOURI RIVER
Stanford
Lewistown
LITTLE BELT MOUNTAINS
BIG BELT MOUNTAINS
HELENA
CANYON FERRY LAKE
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
Roundup
MUSSELSHELL
GOLDEN VALLEY
YELLOWSTONE RIVER
Hysham
Forsyth
Garrison
Deer Lodge
Townsend
Boulder
Radersburg
Anaconda
BUTTE
Three Forks
CRAZY MOUNTAINS
BRIDGER RANGE
Broadview
Colstrip
Big Timber
BILLINGS
Laurel
Hardin
Columbus
Bozeman
Livingston
BITTERROOT MOUNTAINS
Hamilton
SAPPHIRE MOUNTAINS
FLINT CREEK RANGE
PIONEER MOUNTAINS
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION

Figure V-6

Table V-3 VISUAL IMPACT SCORE MATRIX

CONTRAST RATINGS	MANAGEMENT CLASSES				
	Preservation	Retention	Partial Retention	Modification	Maximum Modification
High	HIGH	HIGH	HIGH	MEDIUM	LOW
Moderate	HIGH	HIGH	MEDIUM	LOW	LOW
Low	HIGH	MEDIUM	LOW	LOW	LOW

The final impact rating assignment procedure, as reflected in Table V-3, was based on the following considerations:

High Visual Impacts - Regardless of contrast ratings, all Preservation lands were rated high in recognition of their legal protection. Because the Retention management class required that activities not be visually evident, retention lands with high and medium contrast potential were also given high impact ratings.

Because the Partial Retention class allows human activities to be evident, but not dominant, Partial Retention areas rated both high and medium for contrast were initially included in the high impact category. However because of the resultant poor distribution of highs, mediums, and lows in the study area, medium-rated Partial Retention lands were dropped from the high impact category for the final analysis.

Medium Visual Impacts - Land in the Retention class, where transmission lines would contrast only minimally, was rated medium for visual impact potential. Rating such highly scenic land as "medium" reflects a heavy reliance on the ability of the landscape to absorb the visual intrusion of transmission lines.

Lands in the Modification class have less scenic value than lands in more restrictive management classes; where transmission line contrasts would be high on these lands, medium impact ratings were assigned. Partial Retention lands (i.e., high quality-low sensitivity or lower quality-high sensitivity lands) rated medium for contrast were also rated medium for visual impact. This represents an average transmission line impact, an impact which is likely to be quite substantial.

Low Visual Impacts - All Maximum Modification lands (i.e., lands where visual sensitivity and scenic quality are both relatively low) were assigned low impact ratings regardless of their contrast ratings. Modification lands (i.e., minimal quality lands seldom seen or seen only from points or routes of secondary importance) rated medium or low for contrast were assigned low impact ratings.

Low rated Partial Retention lands (i.e. high quality-low sensitivity or low quality-high sensitivity) were also given low impact ratings.

High ratings were assigned a corresponding numerical value of 4; mediums, 2; and lows, 1. The number of miles of each impact category was multiplied by its corresponding value to obtain a final impact score for each corridor segment.

Determinant Value

The determinant value of 3 (high) has not been changed from Step 1.

RESULTS

CORRIDOR SEGMENT COMPARISONS

Impact scores for each determinant for each Step 2 corridor segment are presented in Table V-4. Total segment impact scores both with and without adjustments for the Parallel Advantage determinant are listed in columns 16 and 19, respectively, for each segment. Unadjusted and adjusted impact scores per mile are listed in columns 17 and 20, respectively. These various scores were used to compare segments, links, and entire corridors. Table V-5 lists the more important quantitative data used in the Step 2 determinants.

Adjusted segment impact scores from column 19 of Table V-4 were used to compare the segments in order to identify the "least-impact" corridor. The comparisons were made without considering their relationships to the alternative corridors. Following the comparisons below, the five Step 2 corridors are compared directly.

Comparison 1.

Link	Miles	Impact Score	Score/mi.	Larger ÷ smaller Total	Per Mi.
B	241.8	7053	29.1		
E+C	226.5	7488	33.1	1.06	1.14

Segment E+C has a 14% higher impact score per mile, but because it is 15.3 miles shorter than segment B, its total impact score is only 6% greater than that for B.

Comparison 2.

Link	Miles	Impact Score	Score/mi.	Total	Per Mi.
D	216.3	6285	29.0		
C+F	217.2	7016	32.7	1.13	1.13

These two links are essentially the same in length, but segment D would have 13% less total and per mile impact. Since the west ends of segments B, C and D do not meet, no least-impact corridor can be identified at this time.

Comparison 3.

I+D	277.5	8116	29.2		
H+E+C	275.0	9825	35.7	1.21	1.22
H+B	290.3	9390	32.4	1.16	1.11

This comparison suggests that segments I and D would result in about 21% and 16% less total environmental impact, respectively, than H+E+C or H+B. Since segment D is lower in potential impact than link C+F (comparison 2), the least-impact corridor to the point of intersection with segment J would involve using segments D and I.

Comparison 4.

H+E	100.5	4479	44.6	1.25	1.29
I+F	103.9	3591	34.6		

Link I+F has a 25% lower total impact score despite being 3.4 miles longer. Thus, should segment C be selected to deliver power to the Helena area, route F+I would be preferable to H+E.

Comparison 5.

G	78.3	3301	42.2		1.05
H+J+K	88.9	3563	40.0	1.07	

Segment G has a 5% higher impact score per mile than does link H+J+K. However, due to its greater length, H+J+K is 7% higher in total potential impact. Because the impact score for link H+E is higher than that for I+F, either G or H+J+K should be selected only if segment B is utilized. In such a case, the apparent lower total impact along segment G would be negated by at least two land management conflicts on this segment. Because of this, plus the lower per mile impact score, H+J+K is the preferred corridor.

Table V-4 - CORRIDOR SEGMENT ANALYSIS AND EVALUATION (STEP 2)

		DETERMINANTS																		
		NATURAL					ECONOMIC			SOCIAL				VISUAL						
CORRIDOR SEGMENT	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATIONAL RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	IMPACT SCORE PER MILE	SCORE ADJUSTMENTS FOR PARALLELING RIGHTS-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED PER MILE IMPACT SCORE
A	111.4	284	334	168	496	33	56	81	200	376	-	339	256	665	3288	29.5	-439	2849	25.6
B	241.4	854	768	358	954	6	324	324	424	1107	**	546	558	1492	7715	31.9	-662	7053	29.1
C	174.5	392	656	321	614	6	228	27	218	762	**C	505	432	1255	5416	31.0	- 70	5346	30.6
D	216.3	588	758	367	814	3	380	168	308	629	**C	519	505	1506	6545	30.3	-260	6285	29.1
E	52.0	148	158	62	288	0	84	195	69	377	-	186	107	468	2142	41.2	0	2142	41.2
F	72.7	124	170	79	192	39	44	48	43	392	**C	125	146	358	1760	41.2	0	1760	41.2
G	78.3	402	270	85	450	0	96	471	122	547	*#	183	234	736	3596	45.9	-295	3301	42.2
H	48.5	270	168	49	328	0	40	408	116	254	##	119	133	505	2390	49.3	- 53	2337	48.2
I	61.2	278	196	61	268	0	48	93	93	308	-	180	244	385	2154	35.2	-323	1831	29.9
J	4.7	16	18	5	22	0	8	12	5	38	-	11	19	28	182	38.7	- 25	157	33.4
K	35.7	88	102	36	158	0	60	108	36	149	-	103	149	245	1234	34.5	-165	1069	30.0
L	16.1	32	56	16	50	0	36	0	16	48	-	92	46	82	474	29.4	- 64	410	25.5
M	57.2	316	168	62	260	0	180	273	174	290	C#	172	213	482	2590	45.3	0	2590	45.3

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table V-5 - CORRIDOR SEGMENT SUPPLEMENTAL QUANTITATIVE INFORMATION (STEP 2)

CORRIDOR SEGMENT	LENGTH (in miles)	FEDERAL LANDS	INDIAN RESERVATION LANDS (miles)	STATE AND PRIVATE LANDS (miles)	TOTAL FOREST LAND CUT (acres, includes R-O-W and Roads)	VOLUME OF TIMBER REMOVED (MCF, includes R-O-W and Roads)	AGRICULTURAL LAND/IRRIGATED LAND (acres removed from production)	RANGELAND REMOVED FROM FORAGE PRODUCTION (acres/AUM's)	HIGH SEDIMENT RISK (miles)	POOR SUITABILITY FOR TRANSMISSION LINES (miles)	EXISTING R-O-W PARALLELED* (miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATIONAL WATERWAYS (# crossed/miles paralleled**)	STATE PARKS AND RECREATIONAL AREA (existing/proposed)	SCENIC TRAVELWAYS (# crossed/miles paralleled**)	HISTORIC TRAILS (# crossed/miles paralleled**)	NATIONAL REGISTER & HISTORIC SITES	ELK WINTER RANGE/KEY ELK AREAS (miles of forested land)	MULE DEER AND WHITE-TAILED DEER (miles of key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (miles)
A	111.4	2.1	0	109.3	643	547	39 / .3	255/ 71	0	0	111.4/ 0	59/0	18/11	1/ 6	14/10	0/ 0	2	0/0	0	0
B	241.4	10.3	0	231.5	1480	2854	222 /1.6	562/158	3	3	160 / 0	155/2	58/68	27/14	32/57	2/ 0	4	2/0	2	17
C	174.5	20.3	0	154.2	204	392	146 /1.6	391/123	10.2	10.2	27 /34	65/1	29/53	15/18	26/59	1/27	13	0/1	1	0
D	216.3	27.5	0	188.8	1288	2921	223 /3.6	513/149	11.6	12.6	90 /18	110/0	40/119	13/17	32/95	1/ 4	1	6/12	2	0
E	52.0	13.2	0	38.8	1150	2220	18 /2	142/ 37	0	0	0 / 0	16/0	14/ 30	4/ 4	7/34	2/ 3	3	2/0	1	0
F	72.7	10.6	0	32.1	355	685	4.5/1.3	114/ 28	10.9	10.9	0 / 7	11/0	8/19	5/ 9	8/20	3/22	3	6/0	1	0
G	78.3	14.8	39.3	24.2	1922	4612	52 /1	198/ 62	0	7.1	78.3/ 0	38/3	12/87	11/10	11/39	0/ 0	4	8/0	3	15
H	48.5	14.6	0	33.9	1608	3859	14 / .8	146/ 20	0	0	19 / 0	15/1	7/21	5/ 2	5/ 4	0/ 0	0	1/0	0	0
I	61.2	5.9	0	55.3	452	1084	20 / .8	153/ 52	0	0	61.2/58	26/1	10/55	7/14	13/20	0/ 0	5	0/0	1	0
J	4.7	0	0	4.7	48	115	.3/ .3	10/ 5	0	0	4.7/ 4	2/0	3/ 0	0/ 0	0/ 0	0/ 0	0	0/0	0	0
K	35.7	0.7	32.2	2.8	395	946	23 /1	76/ 38	0	0	35.7/29	21/0	4/37	2/ 4	7/24	0/ 0	1	1/0	0	0
L	16.1	0	16.1	0	0	0	17 / .5	34/ 17	0	0	16.1/ 0	9/0	3/ 9	0/ 2	2/ 6	0/ 0	0	0/0	0	0
M	57.2	28.4	0	28.8	984	2364	52 / .3	170/ 34	0	4.4	0 / 0	44/0	10/54	2/ 7	6/64	0/ 0	8	18/2	1	0

* The first number refers to 100-kV and above powerlines. The second number refers to fossil fuel pipelines.

** Paralleling is measured if within 3 miles of the corridor center.

Comparison 6.

F+I+J+K	144.3	4817	33.3		
E+G	130.3	5443	41.8	1.12	1.25

This comparison further supports not utilizing segment E. The per mile impact score on link E+G is 25% higher than on link F+I+J+K, and even though this latter link is 14 miles longer, the total impact scores favor this link by 12%.

Comparison 7.

L+K	51.8	1479	28.5		
M	57.2	2590	45.3	1.75	1.59

This comparison demonstrates a large advantage (75%) for delivering power to Hot Springs rather than to Plains. The impact score per mile of segment M is 59% greater than that of link L+K. Segment M is also about 10% longer, making its total impact score much higher.

CORRIDOR COMPARISONS

This same procedure was used to compare the three major corridors which represent the least impact alternatives for the Butte-Anaconda, Helena, and Great Falls plans-of-service. Results suggest that the Butte-Anaconda corridor would be about 7% lower in total potential impact than the Helena corridor, and 10% lower than the Great Falls corridor.

ADIJKL (Butte-Anaconda)	445.4	12601	28.3		
ACFIJKL (Helena)	446.3	13422	30.1	1.07	1.06
ABHJKL (Great Falls)	458.2	13875	30.3	1.10	1.07

Comparisons among the five corridors analyzed in Step 2 are presented in Table V-6. Total corridor impact scores, reflecting adjustments for existing parallel lines, are listed in column 20. Values in column 21 relate the impact scores for each corridor to that of the Applicant's proposed corridor. These comparisons indicate that the Siegel Pass alternative would have about 10% greater potential environmental impact than that of the Applicant's proposal. The Helena and Great Falls corridors are 4% and 1% lower in potential impact, respectively, values which are perhaps not large enough to definitely favor either over the Applicant's proposed corridor. However, the 10% lower impact score for the Butte-Anaconda alternative suggests that choosing this corridor would definitely be advantageous to the existing environment of the study area. Table V-7 shows corridor totals for each of several data sources used for Step 2 analysis.

During both Step 1 and Step 2 analysis and evaluation, it was apparent that there were certain specific problem areas involving lands managed by the Federal Government. If these problem areas could be avoided, the results of direct comparisons among the five Step 2 corridors may change. Step 3 analysis dealt with avoiding these problem areas (see next chapter).

Table V-6 - CORRIDOR ANALYSIS AND EVALUATION (STEP 2)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		DETERMINANTS																					
		NATURAL					ECONOMIC			SOCIAL				VISUAL									
CORRIDORS	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATION RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	TOTAL SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	IMPACT SCORE PER MILE	PER MILE SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	SCORE ADJUSTMENTS FOR PARALLELING EXISTING RIGHT-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	ADJUSTED IMPACT SCORE PER MILE	ADJUSTED PER MILE IMPACT SCORE DIFFERENCE FROM APPLICANT'S PROP.
APPLICANT'S PROPOSED	432.3	1258	1474	652	1898	39	500	774	625	2110	#C***	1305	1075	3206	14916	0	34.5	0	-868	14048	0	32.5	0
SIEGEL PASS	448.3	1426	1502	667	2008	39	596	996	782	2097	** ###CC	1332	1160	3403	16008	+7%	35.7	+3%	-587	15421	+10%	34.4	+6%
HELENA	446.3	1214	1532	686	1800	78	480	369	611	2073	**** CC	1355	1292	3018	14508	-3%	32.5	-6%	-1086	13422	-4%	30.1	-8%
GREAT FALLS	458.2	1544	1446	632	2008	39	524	933	797	1972	**##	1210	1161	3017	15283	+2%	33.4	-3%	-1408	13875	-1%	30.3	-7%
BUTTE-ANACONDA	445.4	1286	1464	653	1808	36	588	462	658	1548	**C	1244	1219	2911	13877	-7%	31.2	-10%	-1276	12601	-10%	28.3	-13%

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table V-7 - CORRIDOR SUPPLEMENTAL QUANTITATIVE INFORMATION (STEP 2)

CORRIDORS	LENGTH (in miles)	FEDERAL LANDS (miles)	INDIAN RESERVATION LANDS (miles)	STATE AND PRIVATE LANDS (miles)	TOTAL FOREST LAND CUT (acres, includes R-O-W and Roads)	VOLUME OF TIMBER REMOVED (MCF, includes R-O-W and Roads)	AGRICULTURAL LAND/IRRIGATED LAND (acres removed from production)	HIGH SEDIMENT (miles)	RANGELAND REMOVED FROM FORAGE PRODUCTION (acres/AUM's)	POOR SUITABILITY FOR TRANSMISSION LINES (miles)	EXISTING R-O-W PARALLELED* (miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATIONAL WATERWAYS (# crossed/miles paralleled**)	STATE PARKS AND RECREATIONAL AREAS (existing and proposed)	SCENIC TRAVELWAYS (# crossed/miles paralleled**)	HISTORIC TRAILS (# crossed/miles paralleled**)	NATIONAL REGISTER & HISTORIC SITES	ELK WINTER RANGE/KEY ELK AREAS (miles of forested land)	MULE DEER AND WHITE-TAILED DEER (miles of key forested area)	PROPOSED GRIZZLEY BEAR CRITICAL HABITAT (miles)
APPLICANT'S PROPOSED	432.3	49.6	55.4	327.3	3919	7771	271 /5.1	1020/310	10	17	2318 / 36.8	187/1	110/196	32/41	60/168	3/23	27	10/ 1	5	15
SIEGEL PASS	448.3	77.8	0	370.5	4637	12026	269.3/5.3	1114/290	10	15	1621 / 38	201/2	81/169	27/37	58/171	3/30	28	21/ 3	3	0
HELENA	446.3	39.6	48.3	358.4	2097	3769	211.3/5.8	1033/334	10	21	256.1/132	193/2	75/184	30/53	70/139	4/49	29	7/ 1	3	0
GREAT FALLS	458.2	27.7	48.3	382.2	4174	8321	315.3/4.5	1083/309	3	3	346.9/ 33	261/3	93/146	35/28	60/101	2/ 0	7	4/ 0	2	17
BUTTE-ANACONDA	445.4	38.9	48.3	358.2	2826	5613	322.3/6.5	1041/332	12	13	319.1/109	227/1	78/231	23/43	68/155	1/ 4	9	7/12	3	0

* The first number refers to 100-kV and above powerlines. The second number refers to fossil fuel pipelines.

** Paralleling is measured if within 3 miles of the corridor center.

PROBLEM AREA ANALYSIS AND EVALUATION

(STEP 3)

PROBLEM AREA ANALYSIS AND EVALUATION (STEP 3)

OBJECTIVES

1. Conduct an environmental analysis on the alternatives identified during Forest Service and Bureau of Land Management meetings held October 13 and 14, 1977, respectively.

2. Compare the corridors through adaptation of the methodology developed for Steps 1 and 2.

ALTERNATIVES TO BE STUDIED AND LEVEL OF ANALYSIS

During the analysis and evaluation of segments and corridors in this study, several specific areas with particularly difficult problem situations became apparent. As a part of Step 2, meetings were held by the Study Team in which Forest Service (FS) and Bureau of Land Management (BLM) personnel participated. Representatives from all FS and BLM Federal Land Management Units within the study area were included. Following these meetings, the FS and the BLM specifically requested that several new segments be developed to avoid the identified problem areas on Federal lands. Step 3 analysis was conducted primarily in response to these problems and requests.

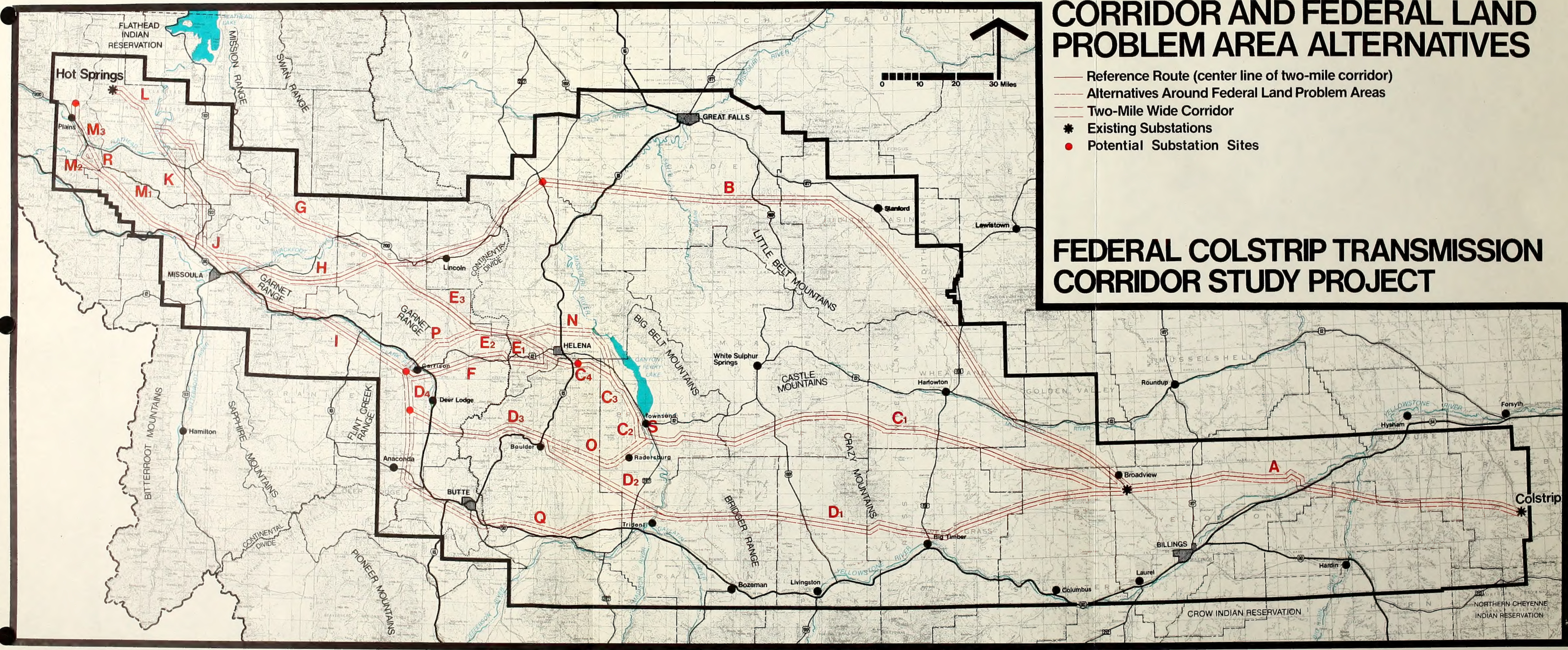
The major problem areas identified, the related Federal Land Management Agency requests, and the new alternative segments generated in response are discussed below and shown on Figure VI-1. Step 2 segments discussed below are shown in Figure V-1. The procedures used in generating the new segments and in conducting the subsequent analysis are discussed later.

a. Segment C crosses the Limestone Hills area southwest of Townsend, an area utilized by the Montana National Guard for military training. Power lines in this area would interfere with these training exercises. Also, the two-mile wide corridor in this area includes an existing communication site of TV translator stations which serve Townsend and the surrounding area. The BLM requested that an alternative corridor be developed to avoid this area. Both segment S and segment O (see Figure VI-1) were generated as viable alternatives to crossing the problem area.

b. Segment C in the vicinity of Helena has several identified problems. Its proximity to residential areas creates concerns by the residents. Southwest of Helena this segment crosses National Forest land which is in the Colorado-Unionville-Travis Planning Unit. The proposed corridor would be in conflict with the proposed management direction specified for this planning unit in its Draft Environmental Statement. In response to these problems, and at the request of the FS, segment N was generated to pass north of Helena across the Helena Valley (see Figure VI-1).

c. Forest Service personnel requested a new alternative to avoid the Boulder-Basin-Alta Gulch areas crossed by segment D. Particularly bad visual impacts in the Boulder-Basin area and impacts on winter elk range were cited as problems. Segment Q is a new connecting segment between segments B27 and A7 of Step 1, continuing along segment A5. By connecting two relatively low impact segments, or portions thereof, it would avoid both the high impact zones identified in Step 1 analysis and the identified problem areas of segment D (see Figure VI-1).

d. A portion of segment F crosses National Forest managed primarily for wildlife habitat, watershed, scenic value, and nonmotorized recreation. Introduction of a power corridor into this area would conflict with these management directives. Since this segment also passes through a RARE II study area, no permits could be issued for a corridor until the RARE II process is completed. It also crosses the Continental Divide near MacDonald Pass, where management directives conflict with the introduction of a power corridor. Segment P was generated to serve as an



CORRIDOR AND FEDERAL LAND PROBLEM AREA ALTERNATIVES

- Reference Route (center line of two-mile corridor)
- Alternatives Around Federal Land Problem Areas
- Two-Mile Wide Corridor
- ✱ Existing Substations
- ● Potential Substation Sites

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Figure VI-1

alternative to these problem areas (Figure VI-1). Segment O (see g. below) was generated to avoid the problem areas in the vicinity of Helena and westward.

e. Segment H crosses a potential wilderness area and an ongoing BLM Elk Logging Study Area (Figure VI-1). A transmission corridor would be an unacceptable land use in either of these areas. There is no viable alternative in the immediate vicinity for circumventing the problem areas of segment H, so this segment must be eliminated from the Great Falls plan-of-service. Segment P would serve as an alternative in the Helena plan-of-service.

f. The portion of segment M which follows Siegel Creek drainage and the Clark Fork River would be untenable due to steep rocky walls near Siegel Creek and a very narrow drainage along the Clark Fork. This sensitive area could be avoided by shifting that portion of the segment from Siegel Pass to near the confluence of the Clark Fork and Flathead Rivers. This was done at the request of the FS, resulting in segment R (Figure VI-1).

g. Segment O had been generated, in part, to avoid problem areas near Helena and Townsend. In addition, this segment would appear to offer certain definite advantages by connecting the low impact portion of the Applicant's proposed corridor with the lowest impact corridor (the Butte-Anaconda alternative) from Step 2 analysis. Segment C from Broadview to Townsend and segment D from Broadview to Trident would have relatively comparable potential environmental impacts; thus, the major advantage of the Butte-Anaconda alternative corridor derives from its lower potential impact in the western part of the study area. Segment O would connect the Applicant's proposed corridor and this lower-impact portion of the Butte-Anaconda alternative corridor.

The new Step 3 segments were located after careful study of each area, including outside studies. Maps, data and other available information from Step 1 and Step 2 analysis were utilized to identify the best location for each segment. Also, helicopter and field reconnaissance from October 31 to November 4, 1977 allowed the Study Team to identify probable areas of least impact for each resource. Although the aerial reconnaissance was more comprehensive than that for Step 2, the level of analysis was the same for both steps (see Chapter V).

New Step 3 segments (Figure VI-1) were labelled with letters from N to S, following the procedure used in Step 2. Each Step 2 segment which was intersected by a new segment was relabelled using number subscripts to identify each portion of the segment (see Figures V-1 and VI-1).

PROCEDURE AND METHODOLOGY

The new segments were mapped on the Step 2 basic 1:500,000 corridor grid map (Figure VI-1). Step 2 methodology was used to derive impact scores for corridor segments (see "Methodology," Chapters IV and V). No changes were made in data items or determinants. Impact scores were derived both without and with adjustments for existing parallel rights-of-way. Results are described in the following section.

RESULTS

CORRIDOR SEGMENT COMPARISONS

Impact scores for each segment of Step 3 analysis are presented in Table VI-1, which shows individual determinant scores as well as total and per mile scores. Values for the Parallel Advantage determinant (see Chapter V, "Methodology") are given in Table VI-2. Subtracting these from the total impact scores yielded the adjusted impact scores (Column 19 of Table VI-1), which are the best indicators to compare overall potential impacts among the various alternative segments. Table VI-3 provides supplemental quantitative information for each of these segments, including cost data.

Table VI-1 - CORRIDOR SEGMENT ANALYSIS AND EVALUATION (STEP 3)

		DETERMINANTS																	
		NATURAL					ECONOMIC			SOCIAL				VISUAL					
CORRIDOR SEGMENT	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATION RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	IMPACT SCORE PER MILE	SCORE ADJUSTMENTS FOR PARALLELING RIGHTS-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED PER MILE IMPACT SCORE
A	111.4	284	334	168	496	33	56	81	200	376	-	339	256	665	3288	29.5	-439	2849	25.6
B	241.8	854	768	358	954	6	324	324	424	1107	**	546	558	1492	7715	31.9	-662	7053	29.2
C_1	134.2	304	482	234	456	6	208	18	165	580	*	306	280	933	3972	29.6	0	3972	29.6
C_2	7.0	14	28	14	26	0	8	0	14	56	*	30	14	72	276	39.4	-4	272	38.9
C_3	13.2	26	42	21	48	0	8	0	19	16	-	75	26	79	360	27.3	-34	326	24.7
C_4	20.1	48	104	52	84	0	4	9	20	110	C	94	112	172	809	40.3	-32	777	38.7
D_1	130.7	302	458	222	436	3	252	36	194	541	**	304	284	919	3951	30.2	-201	3750	28.7
D_2	35.7	72	100	48	104	0	88	0	65	102	-	102	89	207	977	27.3	-5	972	27.2
D_3	39.2	172	178	86	242	0	28	141	39	165	C	88	111	316	1566	40.0	0	1566	40.0
D_4	10.7	36	22	11	38	0	12	0	11	21	-	25	21	64	261	24.4	-54	207	19.3
E_1	8.3	18	30	15	35	0	8	9	8	66	-	21	17	82	309	37.2	0	309	37.2
E_2	11.2	22	44	14	90	0	0	68	11	90	-	26	25	116	506	45.2	0	506	45.2
E_3	32.5	108	84	33	163	0	76	118	50	221	-	139	65	270	1327	40.8	0	1327	40.8
F	42.7	124	170	79	192	39	44	48	43	342	**C	125	146	358	1710	40.1	0	1710	40.1
G	78.3	402	270	85	450	0	96	471	122	547	*#	183	234	736	3596	45.9	-295	3301	42.2
H	48.5	270	168	49	328	54	40	408	116	254	##	119	133	505	2444	50.4	-53	2391	49.3
I	61.2	278	196	61	268	0	48	93	93	308	-	180	244	385	2154	35.2	-323	1831	29.9
J	4.7	16	18	5	22	0	8	12	5	38	-	11	19	28	182	38.7	-25	157	33.4
K	35.7	88	102	36	158	0	60	108	36	149	-	103	149	245	1234	34.5	-165	1069	30.0
L	16.1	32	56	16	50	0	36	0	16	48	-	92	46	82	474	29.4	-64	410	25.5
M_1	36.6	212	88	37	162	0	136	171	92	180	C	113	121	265	1577	43.4	0	1577	43.4
M_2	9.3	52	48	12	72	0	0	102	37	37	#	34	37	112	543	58.4	0	543	58.4
M_3	11.3	52	32	13	26	0	44	0	45	73	-	25	55	105	470	41.6	0	470	41.6
N	32.2	76	88	44	104	0	88	30	32	243	*	104	185	191	1185	36.8	0	1185	36.8
O	30.0	136	112	57	158	0	8	60	44	120	-	74	69	258	1096	36.5	0	1096	36.5
P	23.6	48	72	24	122	0	28	96	56	126	-	79	61	150	862	36.5	0	862	36.5
Q	90.7	222	294	135	342	0	124	42	153	403	-	221	337	633	2906	32.0	-223	2683	29.6
R	8.3	30	42	12	58	9	0	75	33	66	#	27	17	100	469	56.5	0	469	56.5
S	6.0	12	24	12	24	0	0	0	12	48	-	24	12	48	216	36.0	-1	215	35.8

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table VI-2 - ADJUSTMENTS FOR PARALLELING EXISTING POWERLINES (STEP 3)

CORRIDOR SEGMENT	LENGTH (in miles)	FOREST			NONFOREST			TOTAL ADJUSTMENT
		LESS THAN 230 kV (x2.8)*	230 kV (x3.6)*	MORE THAN 230 kV (x6.2)*	LESS THAN 230 kV (x2.6)*	230 kV (x4.0)*	MORE THAN 230 kV (x5.1)*	
A	111.4	-	16.3/-59	-	-	95.1/-380	-	-439
B	241.8	-	34.1/-123	-	-	93.9/-376	32.0/-163	-439
C_1	134.2	-	-	-	-	-	-	0
C_2	7.0	-	-	-	1.5/-4	-	-	-4
C_3	13.2	-	-	-	13.2/-34	-	-	-34
C_4	20.1	-	-	-	12.3/-32	-	-	-32
D_1	130.7	6.0/-16.8	-	-	71.0/-184.6	-	-	-201
D_2	35.7	-	-	-	2.0/-5	-	-	-5
D_3	39.2	-	-	-	-	-	-	0
D_4	10.7	-	-	-	-	-	10.7/-54	-54
E_1	8.3	-	-	-	-	-	-	0
E_2	11.2	-	-	-	-	-	-	0
E_3	32.5	-	-	-	-	-	-	0
F	42.7	-	-	-	-	-	-	0
G	78.3	-	44.3/-159	-	-	34.0/-136	-	-295
H	48.5	19.0/-53	-	-	-	-	-	-53
I	61.2	-	-	10.4/-64	-	-	50.8/-259	-323
J	4.7	-	-	1.1/-7	-	-	3.6/-18	-25
K	35.7	-	0.8/-3	8.3/-51	-	22.9/-92	3.7/-19	-165
L	16.1	-	-	-	-	16.1/-64	-	-64
M_1	36.6	-	-	-	-	-	-	0
M_2	9.3	-	-	-	-	-	-	0
M_3	11.3	-	-	-	-	-	-	0
N	32.2	-	-	-	-	-	-	0
O	30.0	-	-	-	-	-	-	0
P	23.6	-	-	-	-	-	-	0
Q	90.7	7.1/-20	-	-	11.9/-31	43.0/-172	-	-223
R	8.3	-	-	-	-	-	-	0
S	6.0	-	-	-	0.5/-1	-	-	-1

* This Parallel Advantage weight is multiplied by the number of miles (first number) to give the score adjustment value (second number) (see Table V-1).

Adjusted segment impact scores (column 19 of Table VI-1) were used to make paired comparisons between the various segments and links which could connect the same two points in a corridor. The procedure was similar to that described for Step 1 (Chapter IV) by which segments were eliminated based on paired comparisons, and for Step 2 (Chapter V) by which least-impact corridors were identified for the Great Falls, Helena, and Butte-Anaconda plans-of-service. The following comparisons were made to determine the potential benefits of the Step 3 segments by indicating whether the new segments would alleviate the aforementioned problems.

LINK	MILES	ADJUSTED IMPACT SCORE	SCORE/MI	LARGER ÷ SMALLER TOTAL	LARGER ÷ SMALLER PER MI
Comparison 1.					
D_2D_3	74.9	2538	33.9		1.15
Q	90.7	2683	29.6	1.06	
Comparison 2.					
D_1D_2	166.4	4722	28.4		
C_1O	164.2	5068	30.9	1.07	1.09

Segment Q has a 15% lower score for potential environmental impact per mile than does link D_2D_3, but due to its greater length, Q has about a 6% higher total impact score. Link D_2D_3 appears to be the best alternative if segment D_1 is chosen.

Link C_1O would have 7% more potential impact and 9% more impact per mile than does would D_1D_2. Considering only these portions of the corridors, the "D" corridor would appear to be preferable for the Butte-Anaconda plan-of-service.

Table VI-3 - CORRIDOR SEGMENT SUPPLEMENTAL QUANTITATIVE INFORMATION (STEP 3)

CORRIDOR SEGMENT	LENGTH (in miles)	FEDERAL LANDS	INDIAN RESERVATION LANDS (miles)	STATE AND PRIVATE LANDS (miles)	TOTAL FOREST LAND CUT (acres, includes R-O-W and roads)	VOLUME OF TIMBER REMOVED (MCF, includes R-O-W and roads)	AGRICULTURAL LAND/IRRIGATED LAND (acres removed from production)	RANGELAND REMOVED FROM FORAGE PRODUCTION (acres/AUM's)	HIGH SEDIMENT RISK (miles)	POOR SUITABILITY FOR TRANSMISSION LINES (miles)	EXISTING R-O-W PARALLELED* (miles)	WATER BODIES/CLASS I & II FISH STREAMS (# crossed)	RECREATIONAL WATERWAYS (# crossed/miles paralleled**)	STATE PARKS AND RECREATIONAL AREAS (existing/proposed)	SCENIC TRAVELWAYS (# crossed/miles paralleled**)	HISTORIC TRAILS (# crossed/miles paralleled**)	NATIONAL REGISTER & HISTORIC SITES	ELK WINTER RANGE/KEY ELK AREAS (miles of forested land)	MULE DEER AND WHITE-TAILED DEER (miles of key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (miles)	COST (dollars x 10^6)
A	111.4	2.1	0	109.3	643	547	39/ .3	255/71	0	0	111.4/ 0	59/0	18/11	1/ 6	14/10	0/ 0	2	0/ 0	0	0	26.561
B	241.8	10.3	0	251.5	1480	2954	222/1.6	562/158	3	3	160 / 3	155/0	58/68	27/14	32/57	2/ 0	4	2/ 0	2	17	115.466
C_1	134.2	9.0	0	125.2	135	259	136/1.3	301/ 87	2	2	0 / 0	56/1	23/48	11/ 7	21/41	1/20	0	0/ 0	1	0	63.823
C_2	7.0	7.0	0	0	0	0	.3/ .3	19/ 13	0	0	1.5/ 7.0	0/0	1/ 0	0/ 2	2/ 0	0/ 0	0	0/ 0	0	0	3.318
C_3	13.2	0.6	0	12.6	0	0	6/0	28/ 9	0	0	13.2/13.2	5/0	3/ 5	0/ 4	1/13	0/ 0	1	0/ 0	0	0	6.257
C_4	20.1	3.7	0	16.4	69	133	3/0	43/ 14	8	8	12.3/12.8	4/0	2/ 0	4/ 5	2/ 5	0/ 7	17	0/ 1	0	0	9.769
D_1	130.7	6.0	0	124.7	260	712	153/2	302/ 91	0	1	77 / 0	72/0	22/79	6/ 9	21/64	1/ 4	0	2/ 0	2	0	61.454
D_2	35.7	1.7	0	34.0	0	0	52/ .8	84/ 22	0	0	2 / 0	17/0	7/15	1/ 3	4/21	0/ 0	0	0/ 0	0	0	16.922
D_3	39.2	19.8	0	19.4	1028	2209	10/ .5	102/ 26	12	12	0 / 0	14/0	7/24	6/ 5	7/10	0/ 0	1	4/12	0	0	19.292
D_4	10.7	0	0	10.7	0	0	4/3	25/ 10	0	0	0.7/ 1	7/0	4/ 1	0/ 0	0/ 0	0/ 0	0	0/ 0	0	0	5.027
E_1	8.3	1.0	0	7.3	65	126	6/0	18/ 6	0	0	0 / 2.0	3/0	2/ 1	1/ 0	1/ 0	1/ 1	1	0/ 0	0	0	3.934
E_2	11.2	9.4	0	1.8	486	938	0/0	33/ 5	0	0	0 / 2.8	3/0	3/ 5	1/ 0	1/ 4	1/ 2	1	0/ 0	0	0	5.707
E_3	32.5	2.8	0	29.7	599	1156	12/2	83/ 26	0	0	0 / 0	10/0	9/24	2/ 4	5/30	0/ 0	1	2/ 0	1	0	15.732
F	42.7	10.6	0	32.1	355	685	5/1.3	114/ 28	11	11	0 / 7	11/0	8/19	5/ 9	8/20	3/22	3	6/ 0	1	0	21.235
G	78.3	14.8	39.3	24.2	1922	4612	52/1	198/ 62	0	7	78.3/ 0	38/0	12/87	11/10	11/39	0/ 0	4	8/ 0	3	15	38.678
H	48.5	14.6	0	33.9	1608	3859	14/ .8	146/ 20	0	0	19 / 0	15/1	7/21	5/ 2	5/ 4	0/ 0	0	1/ 0	0	0	24.141
I	61.2	5.9	0	55.3	452	1084	20/ .8	153/ 52	0	0	61.2/58	26/1	10/55	7/14	13/30	0/ 0	5	0/ 0	1	0	30.147
J	4.7	0	0	4.7	48	115	.3/ .3	10/ 5	0	0	4.7/ 4	2/0	3/ 0	0/ 0	0/ 0	0/ 0	0	0/ 0	0	0	2.228
K	35.7	0.7	32.2	2.8	395	946	23/1	76/ 38	0	0	35.7/29	21/0	4/37	2/ 4	7/24	0/ 0	1	1/ 0	0	0	17.050
L	16.1	0	16.1	0	0	0	17/ .5	34/ 17	0	0	16.1/ 0	9/0	3/ 9	0/ 2	2/ 6	0/ 0	0	0/ 0	0	0	7.631
M_1	36.6	19.1	0	17.5	616	1479	23/3	106/ 21	0	0	0 / 0	33/0	8/36	1/ 4	3/26	0/ 0	5	16/ 2	0	0	17.206
M_2	9.3	8.8	0	0.5	368	885	0/0	29/ 6	0	3	0 / 0	7/0	1/ 6	1/ 2	2/15	0/ 0	3	0/ 0	0	0	4.849
M_3	11.3	0.5	0	10.8	0	0	29/ .3	35/ 7	0	2	0 / 0	4/0	1/12	0/ 1	1/23	0/ 0	0	2/ 0	0	0	5.613
N	32.2	3.2	0	29.0	135	259	52/ .8	69/ 23	0	0	0 / 4.8	12/0	5/26	1/21	8/ 0	3/ 1	0	0/ 0	0	0	15.263
O	30.0	14.7	0	15.3	425	884	.3/ .3	81/ 16	0	0	0 / 0	14/0	5/ 0	1/ 1	2/ 0	0/ 0	1	9/ 0	9	0	14.504
P	23.6	1.0	0	22.6	391	800	4/ .8	63/ 19	0	0	0 / 0	7/0	5/ 2	1/ 2	1/ 6	1/ 0	15	0/ 0	0	0	11.485
Q	90.7	15.2	0	75.5	308	668	62/1.6	216/ 74	5	5	62 /52.4	35/0	15/21	5/10	12/24	0/ 0	2	2/ 0	0	0	43.831
R	8.3	7.3	0	1	269	646	0/0	26/ 5	0	3	0 / 0	1/0	1/ 0	0/ 0	2/ 4	0/ 0	1	0/ 0	0	0	4.328
S	6.0	6.0	0	0	0	0	0/0	16/ 3	0	0	5/ 6.0	0/0	1/ 6	1/ 3	2/20	0/ 0	0	0/ 0	0	0	2.844

* The first number refers to 100-kV and above powerlines. The second number refers to fossil fuel pipelines.

** Paralleling is measured if within 3 miles of the corridor center.

Comparison 3.

C_4E_1	28.4	1086	38.2		1.04
N	32.2	1185	36.8	1.09	

A north alternate corridor segment around Helena is represented by segment N. This segment has a 9% higher score for potential impact than does the portion of the Applicant's proposed corridor south of Helena represented by link C_4E_1. This greater total impact score derives from greater length, because the impact per mile is 4% less on segment N. However, the benefits of a northern corridor around Helena appear questionable due to the greater total potential impact from this corridor segment.

Comparison 4.

E_1E_2P	43.1	1677	38.9		
F	42.7	1710	40.1	1.02	1.03

There is only a slight 2-3% difference in potential impact scores between these two links. Selection of either should probably be based on (1) whether segment N is utilized; and (2) possible avoidance of problem areas along the Continental Divide. The slightly favorable score for the E_1-P link might be adequate reason for avoiding the sensitive MacDonald Pass area crossed by segment F, especially considering the other problems related to segment F.

Comparison 5.

S	6.0	215	35.8		
C_2	7.0	272	38.9	1.27	1.09

Segment S, a shorter corridor segment which would avoid problem areas in the Limestone Hills, has a total potential impact score 27% lower than that of Segment C_2 which it would replace. This large potential benefit should justify choosing the new segment, especially since it was generated to avoid problems associated with the Applicant's proposed corridor in this area.

Comparison 6.

M_2	9.3	543	58.4	1.16	1.03
R	8.3	469	56.5		

The newly generated segment R not only both would avoid certain land management problems along segment M_2, it also has a lower total potential impact score. Since R would have three percent less impact per mile, would be one mile shorter in length, and would have a combined 16% lower total impact, eliminating the M_2 portion of this corridor is justified.

Comparison 7.

OD_3D_4	79.9	2869	35.9		
$SC_3C_4E_1E_2P$	82.4	2995	36.3	1.04	1.01

The slightly longer S-P link has a 4% higher impact score than does the O-D_4 link. Thus, the O-D_4 link appears to be the slightly favorable route from the junction south of Townsend to the Garrison area.

Comparison 8.

OD_3D_4IJK	181.5	5926	32.7		
$SC_3C_4E_1E_2E_3G$	169.6	6761	39.8	1.14	1.22

Comparing these alternative links between Townsend and their junction with segment L near Moise reveals a 14% lower potential impact score for the O-K link than the S-G link (Applicant's proposed corridor) despite the somewhat greater distance crossed by the former.

Comparison 9.

SC_3C_4F	82.0	3028	36.9	1.06	1.03
OD_3D_4	79.9	2869	35.9		

To connect Townsend and Garrison, using link OD_3D_4 would cause 4% less impact than using link $SC_3C_4E_1E_2P$ (Comparison 7). Replacing link E_1E_2P with segment F in this comparison increases the difference in favor of OD_3D_4 to 6%.

Comparison 10.

E_3G	110.8	4628	41.8	1.18	1.34
PIJK	125.2	3919	31.3		

The considerably longer PIJK link has an adjusted impact score 18% lower than the E_3G link of the Applicant's proposed corridor. This results from the much higher potential impact per mile (34% higher) on the E_3G link. These larger differences suggest that, regardless of the corridor used to arrive at Garrison, the IJK portion of the corridor should be selected rather than link E_3G.

Table VI-4 summarizes the above paired comparisons. These comparisons are supplemented below by comparisons of entire corridors.

CORRIDOR COMPARISONS

Using the new Step 3 segments added three new alternative corridors to the five analyzed in Step 2. Also, some of the Step 2 corridors were changed by incorporating the new segments S and R into the Applicant's proposed corridor, the Helena plan-of-service and the Siegel Pass alternative, and by rearranging the Great Falls plan-of-service to include segment G in place of the non-viable segment H. The final eight Step 3 corridors and their constituent segments are as follows:

Table VI-4 - MAJOR STEP 3 LINK COMPARISONS

COMPARISON	LINKS	MILES	ADJUSTED TOTAL IMPACT SCORE	PER CENT DIFFERENCE	ADJUSTED PER MILE IMPACT SCORE	PER CENT DIFFERENCE
1	D_2D_3	74.9	2538		33.9	
	vs.			6%		15%
	Q	90.7	2683		29.6	
2	C_1O	164.2	5068		30.9	
	vs.			7%		9%
	D_1D_2	166.4	4722		28.4	
3	C_4E_1	28.4	1086		38.2	
	vs.			9%		4%
	N	32.2	1185		36.8	
4	E_1E_2P	43.1	1677		38.9	
	vs.			2%		3%
	F	42.7	1710		40.1	
5	S	6.0	215		35.8	
	vs.			27%		9%
	C_2	7.0	272		38.9	
6	M_2	9.3	543		58.4	
	vs.			16%		3%
	R	8.3	469		56.5	
7	$SC_3C_4E_1E_2P$	82.4	2995		36.3	
	vs.			4%		1%
	OD_3D_4	79.9	2869		35.9	
8	$SC_3C_4E_1E_2E_3G$	169.6	6761		39.8	
	vs.			14%		21%
	OD_3D_4IJK	181.5	5926		32.7	
9	SC_3C_4F	82.0	3028		36.9	
	vs.			6%		2%
	OD_3D_4	79.9	2869		35.9	
10	E_3G	110.8	4628		41.8	
	vs.			18%		34%
	PIJK	125.2	3919		31.3	

Corridor	Segments	Length (miles)
Applicant's Proposed	$A-C_1-S-C_3-C_4-E_1-E_2-E_3-G-L$	431.3
Siegel Pass	$A-C_1-S-C_3-C_4-E_1-E_2-E_3-H-J-M_1-R-M_3$	446.3
Great Falls	A-B-G-L	447.6
Helena (McDonald Pass)	$A-C_1-S-C_3-C_4-F-I-J-K-L$	445.3
Helena (Avon Valley)	$A-C_1-S-C_3-C_4-E_1-E_2-P-I-J-K-L$	445.7
Townsend-Boulder	$A-C_1-O-D_3-D_4-I-J-K-L$	443.2
Trident-Boulder	$A-D_1-D_2-D_3-D_4-I-J-K-L$	445.2
Butte-Anaconda	$A-D_1-Q-D_4-I-J-K-L$	461.2

The determinant impact scores are summarized by corridor in Table VI-5. All eight potential corridors from Step 3 are listed. The adjusted impact scores of column 20 are the best overall values for comparisons among these corridors. The corridor impact scores for the five Step 2 corridors listed differ from the Step 2 scores (Chapter V; Table V-6) because of the inclusion of Step 3 segments in each of them, or due to rearrangement (i.e., the Great Falls alternative) of the corridors.

Using the Applicant's proposed corridor as a basis for comparison, the Trident-Boulder and Butte-Anaconda alternatives are the "least-impact" corridors. There is essentially no difference between the two. They are 9% and 8% lower, respectively, in potential environmental impact than the Applicant's proposed corridor, followed by (1) the Townsend-Boulder alternative with 6% less impact than Applicant's proposal; (2) the two Helena alternatives, (5% less); and (3) the Great Falls alternatives (2% less). The Siegel Pass alternative total adjusted impact score is 10% higher than the score for the Applicant's proposed corridor.

Table VI-6 provides supplemental quantitative information at the corridor level for these eight Step 3 alternative corridors. Cost data, by corridor, is as follows:

Alternative	Cost $(\times 10^6)$
Applicant's Proposed	$181.026
Siegel Pass	$188.233
Great Falls	$188.427
Helena (McDonald Pass)	$187.636
Helena (Avon Valley)	$187.526
Townsend-Boulder	$186.399
Trident-Boulder	$186.446
Butte-Anaconda	$193.523

Table VI-5 - CORRIDOR ANALYSIS AND EVALUATION (STEP 3)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		DETERMINANTS																					
		NATURAL					ECONOMIC			SOCIAL				VISUAL									
CORRIDORS	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATION RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	TOTAL SCORE PERCENT DIFFERENCE FROM APPLICANT'S	IMPACT SCORE PER MILE	PER MILE SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	SCORE ADJUSTMENTS FOR PARALLELING EXISTING RIGHTS-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	ADJUSTED PER MILE IMPACT SCORE	ADJUSTED PER MILE SCORE PERCENT DIFFERENCE FROM APPLICANT'S
APPLICANT'S PROPOSED	431.3	1256	1470	650	1896	39	492	774	623	2102	** #C	1299	1073	3183	14857	0	34.4	0	-865	13992	0	32.4	0
SIEGEL PASS	446.3	1402	1492	665	1992	102	588	969	776	2118	CC* ###	1319	1138	3368	15929	+7%	35.7	+3%	-584	15345	+10%	34.4	+6%
GREAT FALLS	447.6	1572	1428	627	1950	39	512	876	762	2078	** *#	1160	1094	2975	15073	+1%	33.7	-2%	-1460	13613	- 2%	30.4	-7%
HELENA (MACDONALD PASS)	445.3	1212	1528	684	1798	78	472	369	609	2015	CC ***	1349	1290	2995	14399	-3%	32.3	-7%	-1083	13316	- 5%	29.9	-8%
HELENA (AVON VALLEY)	445.7	1176	1504	658	1853	39	464	494	641	1955	*C	1350	1247	2985	14366	-3%	32.2	-7%	-1083	13283	- 5%	29.7	-9%
TOWNSEND-BOULDER	443.2	1346	1500	674	1888	39	464	513	609	1805	*C	1218	1195	2976	14227	-5%	32.1	-7%	-1070	13157	- 6%	29.7	-9%
TRIDENT-BOULDER	445.4	1280	1464	653	1814	36	588	471	659	1748	C **	1244	1219	2911	14085	-5%	31.6	-9%	-1276	12809	- 9%	28.8	-13%
BUTTE-ANACONDA	461.2	1258	1480	654	1810	36	596	372	708	1884	**	1275	1356	3021	14450	-3%	31.3	-10%	-1494	12956	- 8%	28.1	-15%

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table VI-6 - CORRIDOR SUPPLEMENTAL QUANTITATIVE INFORMATION (STEP 3)

CORRIDORS	1 LENGTH (in miles)	2 FEDERAL LANDS (miles)	3 INDIAN RESERVATION LANDS (miles)	4 STATE AND PRIVATE LANDS (miles)	5 TOTAL FOREST LAND CUT (acres, includes R-O-W and roads)	6 VOLUME OF TIMBER REMOVED (MCF, includes R-O-W and roads)	7 AGRICULTURAL LAND/IRRIGATED LAND (acres removed from production)	8 RANGELAND REMOVED FROM FORAGE PRODUCTION (acres/AUM's)	9 HIGH SEDIMENT RISK (miles)	10 POOR SUITABILITY FOR TRANSMISSION LINES (miles)	11 EXISTING R-O-W PARALLELED* (miles)	12 WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	13 RECREATIONAL WATERWAYS (# crossed/miles paralleled**)	14 STATE PARKS AND RECREATIONAL AREAS (existing/proposed)	15 SCENIC TRAVELWAYS (# crossed/miles paralleled**)	16 HISTORIC TRAILS (# crossed/miles paralleled**)	17 NATIONAL REGISTER & HISTORIC SITES	18 ELK WINTER RANGE/KEY ELK AREAS (miles of forested land)	19 MULE DEER, AND WHITE-TAILED DEER (miles of key forested area)	20 PROPOSED GRIZZLEY BEAR CRITICAL HABITAT (miles)
APPLICANT'S PROPOSED	431.3	49.4	55.4	326.5	3919	7771	271/5.1	1008/304	10	17	232/37	187/1	110/196	32/41	60/168	3/23	27	12/1	5	15
SIEGEL PASS	446.3	76.1	0	370.2	4538	9258	268/9.0	1098/282	10	15	161/41	195/2	81/169	27/36	58/180	3/30	29	21/3	3	0
GREAT FALLS	447.6	27.9	55.4	365.0	4045	8013	330/3.4	1050/307	3	10	366/3	261/0	91/175	39/32	59/112	2/0	10	10/0	5	32
HELENA (MACDONALD PASS)	445.3	38.6	48.3	358.4	2097	3769	249/5.5	1029/336	21	21	255/130	193/2	75/190	31/54	70/169	4/49	29	7/1	3	0
HELENA (AVON VALLEY)	445.7	39.4	48.3	358.0	2684	4948	254/5.0	1029/326	10	10	255/128	195/2	77/179	29/51	65/159	4/30	43	1/1	2	0
TOWNSEND-BOULDER	443.2	52.2	48.3	342.7	3126	6044	250/5.3	1038/296	15	14	240/92	208/2	77/185	28/39	66/121	1/20	10	14/12	2	0
TRIDENT-BOULDER	445.4	36.2	48.3	360.9	2826	5613	318/6.5	1043/332	12	13	319/92	227/2	78/231	24/43	68/165	1/4	9	7/12	3	0
BUTTE-ANACONDA	461.2	29.9	48.3	383.0	2106	4072	318/6.8	1073/356	5	6	379/144	231/2	79/213	21/45	69/158	1/4	10	5/0	3	0

* The first number refers to 100-kV and above powerlines. The second number refers to fossil fuel pipelines.

** Paralleling is measured if within 3 miles of the corridor center.

POTENTIAL IMPACTS FROM THE APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

POTENTIAL IMPACTS FROM THE APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

CLIMATE AND AIR QUALITY

DISCUSSION

Climate

Construction and operation of the proposed transmission lines would not impact the regional climate. Construction activities could indirectly cause small localized impacts in areas of dense vegetation. Ground cover removed during access road construction and overstory removed during right-of-way clearing could allow higher wind speeds to occur near the ground. This could reduce ground level humidity and slightly alter soil temperatures.

Since minimal climatic impacts are associated with transmission line construction, operation and maintenance, there would not be significant impact differences between alternate corridors.

Air Quality

Construction, operation and maintenance of a transmission line along any of the alternate corridors would not significantly alter the region's air quality. Impacts on air quality would be short-lived, localized inconveniences of construction, with no long-term effect on the atmosphere.

Excavation, road construction and operation of equipment over dirt roads could result in local dust pollution. Generally, the dust would settle quickly within the right-of-way. During windy periods, the dust would be quickly dispersed, with impacts depending on the proximity of the activity to homes or urban development.

Vehicle and equipment exhaust could temporarily pollute the local work area, with negligible effects on adjacent areas.

In heavily vegetated areas right-of-way clearing would require slash disposal. Burning of the slash would introduce smoke (combustion by-products) into the atmosphere, a one-time local impact.

This impact would be a function of local weather conditions and the rate of atmospheric dispersal. Slash burning procedures would conform with local, state, and Federal air pollution regulations.

Operation of the transmission lines would produce very minor amounts of oxidants (ozone and nitrous oxide). These are produced by small irregularities on the conductor surface (usually dust, water droplets, or insects) which cause a distortion in the electrical field. This results in a breakdown of air immediately adjacent to the conductor, causing ionization. Experience and studies to date indicate that the amount of oxidants produced are minimal and have no adverse effects on humans, animals, or plants (see "Electrical Effects," Chapter II).

During maintenance, vehicle operation on dirt roads could also produce local short-term dust pollution.

CORRIDOR COMPARISONS

The most significant impact to air quality would be the short-term impacts related to slash disposal. Impacts would be directly related to acres of forest land cleared for right-of-way and access roads (see Table VI-6, column 5). These are summarized below:

Corridor	Acres of Forest Cleared
Applicant's Proposed	3919
Siegel Pass	4538
Great Falls	4045
Helena (MacDonald Pass)	2097
Helena (Avon Valley)	2684
Townsend-Boulder	3126
Trident-Boulder	2826
Butte-Anaconda	2106

GEOLOGY AND MINERAL RESOURCES

DISCUSSION

Wide variability exists in the kinds and characteristics of geologic materials within the study area. Also, many of the geologic formations have widely differing properties at different localities, dependent both on characteristics inherent to the deposits, and on special, localized circumstances, such as ground water or physiography.

Due to limitations of available information, geologic elements of environmental concern in transmission line construction are frequently difficult to identify. Mass movement hazards, such as landslides, are difficult to foresee, although some areas where these events have occurred in the past may be readily identified. Furthermore, some potential geologic conflict areas are so localized as to be unimportant in selection of a 2 mile-wide corridor. Most local problem areas could be avoided in the final line location.

The most widespread and common impacts of transmission line construction result from earthmoving activity. Specific examples of these impacts include:

1. removing and burying soil during access road construction and tower site preparation;

2. scarring of landscapes and specific geologic features of special interest;

3. inducing hillslope mass failures; and

4. disturbing certain materials, which would complicate or preclude effective reclamation.

Road construction and site preparation require the greatest extent of excavation; soil loss is greatest when these activities are undertaken on steep slopes. The total amount of soil area removed by cut and fill activities often exceeds the width of the road surface. The steeper the terrain, the wider the area of soil affected by road construction. Terrain that necessitates sharp bends in access roads at gullies, sharp plunging ridges, and switchbacks, requires additional excavation to permit passage of large equipment.

The State of Montana EIS (Section 6.1.1.1; DNRC/DEIS 1974) groups physiographic subdivisions according to excavation requirements. These are ranked on a scale of 1 to 5, 1 representing essentially no impact created by access road construction and site leveling, and 5 representing extreme impact.

Characteristics of a 5 rating are extensive. Continuous road construction is necessary, with length of roads much greater than the length of lines, frequently by a factor of 1.5 or more. Very steep hillsides would also maximize the amount of disturbed soil. This extreme example is well illustrated by the access road along the 1973 Montana Power Company 230-kV transmission line that crosses the Little Wolf Mountains, about 15 miles west of Colstrip.

Because road building and site preparation cause the major adverse geologic impact of transmission line construction, the presence of existing secondary and unimproved roads and ease of off-road travel are significant environmental considerations. Logging areas, which generally contain good quality secondary roads, offer a distinct advantage over roadless areas. The potential for most undesirable effects resulting from earth moving can be minimized or eliminated by routing a transmission line corridor across level terrain requiring little excavation or through areas already having roads.

Several construction activities may contribute to hillslope mass failures. Undercutting of slopes is the most common cause of landslides. Sensitive slopes may be overloaded by the weight of equipment. Slope failure may also be induced by saturation resulting from artificial ponding of surface runoff waters; this may be prevented by proper construction practices.

The possible consequences of slope failure include: personal injury, damage to property, damming and siltation of streams, landscape scars, soil loss, and creation of undrained depressions which may be hazardous to livestock or promote further sliding. Even minor slope disturbances may create significant visual impact. For example, talus in western Montana is frequently blackened by slow-growing lichen. Even minor disturbance of the slopes would reorient many of the rocks, creating a conspicuous, light-colored scar.

Certain geologic terrains, frequently local in extent, are inherently unfavorable to revegetation of excavated sites. Areas of clinker, where coal seams have burned in situ, are common in the eastern coal areas. They may be nearly impossible to reclaim even with replacement of topsoil, due to the high permeability of the disturbed material. Similarly, in areas of existing shale badlands, excavation is likely to aggravate rapid erosion, preclude effective restoration, and make maintenance of access roads a continuous problem. In a large area of shale near the south end of the Big Belt Mountains west of Ringling, extreme erosion results when vegetation is disturbed. Careful siting of access roads and tower sites or alternative construction practices, such as the use of helicopters, may effectively eliminate many adverse geologic impacts.

The physical presence of transmission lines may interfere with exploitation of geologic resources. At the least, the presence of transmission towers and lines in mining areas may cause inconvenience; at the extreme, the transmission facilities may preclude mining of some areas and present a safety hazard to the operation of large equipment.

Many of the geologic resources that occur as sedimentary units, particularly gravel, clay, limestone, and building stone, are widespread enough that the amount of production precluded by transmission line towers would be insignificant. Surface mining for some of these materials is presently being conducted within a number of BPA transmission corridors (BPA 1974).

No detrimental impact on active mining or on the development of local mineral resources need result from the proposed transmission facility. Areas of potential surface mining would be avoided by locating centerlines appropriately within the selected corridor. Transmission line location through an area of underground mining operations within a corridor would not pose problems because shaft, tunnels, and aboveground tailings can be located to avoid direct conflict with the transmission lines without restricting mining operations.

CORRIDOR COMPARISONS

Applicant's Proposed

The corridor preferred by the Applicant, properly located and engineered, would create few impacts to geology or mineral resources. Most problem areas occur in the western portion of the route where there are steep slopes, especially in the Jocko River vicinity.

The landslide hazards map (Figure III-3) shows the corridor passing through moderate or lower classifications except for a small moderate to severe area west of Helena.

Siegel Pass Alternative

As with the Applicant's proposed, a properly located and engineered line within the corridor would cause few impacts. However, rugged, steep terrain could cause location problems east of Missoula and along Siegel Creek north of Siegel Pass.

This corridor crosses the same landslide hazard classifications as the Applicant's proposed.

Helena Alternatives (MacDonald Pass and Avon Valley)

As with the previous alternatives, a properly located and engineered line would create few impacts within the corridor. However, this corridor would encounter more steep slopes (along the Clark Fork) than would the Applicant's corridor.

Great Falls Alternative

This corridor would cross less mountainous terrain than the other alternatives. However, the same holds true that a properly located and engineered line would create few impacts.

An area classified severe for landslide hazard is crossed in the vicinity of Rogers Pass. Precautions during the location stage would probably by-pass any problems.

Townsend-Boulder, Trident-Boulder and Butte-Anaconda Alternatives

Proper location and engineering within these corridors would minimize impacts. Steep slopes along the Clark Fork could cause problems in location.

SOILS

DISCUSSION

The impacts on soils can be grouped into two broad categories: (1) the loss of soil through accelerated erosion, and (2) a decrease in the value of the soil as a medium for plant growth due to compaction, obliteration of the soil profile, and loss of soil nutrients. These impacts would be of greatest magnitude during construction, but they would persist to a lesser degree as long as the corridor and access roads are maintained. Contamination by herbicides could be a third potential impact, but since the applicant has declared that, "Herbicides will not be used during construction or maintenance of this line" (WESD/AEA 1973:3-81), it is considered irrelevant except for the BPA-Build Alternative, as discussed later in this chapter.

Most of the increase in erosion would be by water erosion associated with the construction and maintenance of access roads. This increase could be dramatic. For example, "Studies show that sediment eroded from building and road construction sites is approximately 10 times greater than sediment yields from an equivalent amount of land in cultivated row crops, 200 times greater than sediment yields from pasture land, and 2,000 times greater than sediment yields from forest land" (BPA 1977: VII-6). This conclusion is also supported by research done on logging roads (Megahan and Kid 1972; Fredriksen 1972). Increased erosion would also result from the construction of tower footings, staging areas, and substations, but the total area disturbed by these facilities would be quite small compared to that disturbed by access roads. Access roads would disturb an area from 25 to 60 feet wide, depending on topography. The length of new access roads needed would vary from 0.4 to 1.6 miles of road per mile of corridor, depending upon topography and existing rights-of-way (WESD/AEA 1973:3-92).

The rate of water erosion is dependent upon the inherent erodibility of the soil, rainfall, cover (i.e., vegetation, mulch, etc.), and slope length and gradient (USDA, Soil Conservation Service 1975b). Land

Suitability Pattern for Electrical Transmission Lines (Figure III-6; USDA Forest Service 1976a) includes for each mapping unit a rating of the water erosion hazard for subsoils exposed by cut and fill road construction and compaction by vehicular traffic. The erosion hazard ratings for those mapping units which are crossed by transmission corridors are as follows (see Figure III-6):

Ratings	Mapping Units
low	A_2, B_3, M_2, M_3, M_7, M_{13}, M_{14}, M_{25}
moderate	B_1, B_2, B_4, F_1, F_2, F_3, F_4, F_5, F_6, F_7, M_1, M_4, M_9, M_{12}, M_{18}, M_{20}, P_1, P_4, P_5, P_6, P_7
severe	M_8, P_3

(The erosion hazard for the Colstrip to Broadview area, which is not covered by the above map, is moderate except along the Yellowstone and Little Bighorn Rivers where it is low.)

A low rating indicates that the erosion hazard may be overcome by normally used erosion control devices, such as waterbars and cross drains, with no special treatment required. A moderate rating indicates that special measures which are costly to apply (e.g., culverts or mulch would be required to control erosion). A severe rating indicates that the number and kind of erosion control practices needed would be very costly, and even with these practices satisfactory erosion control may not be possible.

Wind erosion and soil mass movement (landslides and slumps) are two additional forms of erosion which could cause accelerated soil loss. Wind erosion would not be expected to be significantly increased by construction of the transmission lines because (1) none of the mapping units crossed by transmission corridors have a severe wind erosion hazard (USDA Forest Service 1976a), and (2) the expanse of soil exposed by access roads is not great enough to alter existing wind erosion conditions as interpreted from Cooperative Extension Service and Ohio State University (1975).

Soil mass movement is not an extensive problem within the study area, but it is very significant where it occurs. Soils which are inherently susceptible to mass movement can be aggravated by construction of access roads, tower footings, substations, and other transmission line facilities. The M_{18} Land Suitability mapping unit is particularly susceptible to soil mass movement. Other mapping units crossed by transmission corridors which are less susceptible to mass movement are M_7, M_{12}, M_{14}, and M_{20}. The corridor segments which cross mapping unit F_1, also susceptible, were eliminated in Step 1 of this analysis.

A second broad category of soils impacts, involves decreasing the value of the soil as a medium for plant growth. Impacts would depend on complex relationships among many soil properties, including tilth, bulk density, water holding capacity, infiltration capacity, percolation and fertility.

Soil tilth refers to the structure and "workability" of the soil. Bulk density is the weight of the soil per unit volume (grams per cubic centimeter or pounds per cubic foot), and it is an indication of the amount of pore space within the soil. Compaction from vehicular traffic, such as would occur on access roads, causes a deterioration in soil tilth and an increase in bulk density. Soil tilth and bulk density would be similarly affected where soil is excavated and compacted around substations and tower footings. If the resulting soil is compacted to the point that it has poor tilth and high bulk density, penetration of the soil by plant roots would be difficult and plant growth would be impaired (Bernier and Winget 1975:387).

Water moves through the soil following the larger pores (spaces between soil particles), and it is held in the smaller pores by adhesion and cohesion (Millar, et al. 1965:55). When the soil is compacted, the total amount of pore space is reduced, which in turn reduces both the capacity of the soil to hold water and the ability of water to move through the soil (percolation). The net effect is more rapid depletion of soil moisture during periods of drought, and more rapid saturation during periods of plentiful rainfall. Both of these conditions are detrimental to plant growth.

Infiltration is the process by which water enters the soil through the surface. The infiltration rate is frequently controlled by the percolation rate: water cannot move into the soil for sustained periods any faster than it can move through the soil. Compaction which decreases the percolation rate will subsequently decrease the infiltration rate. A decrease in infiltration will result in an increase in runoff and a corresponding increase in erosion.

Construction of electric transmission lines would cause a loss of soil fertility in two general ways: (1) scarification and erosion on access roads, staging areas, and other construction sites could result in the loss of all or part of the soil surface layer (A horizon); and (2) in areas where forest vegetation is removed for right-of-way clearing, increased volumes of water moving through the ecosystem would cause an increase in the leaching of soil nutrients.

The relatively thin A horizon contains nearly all of the nitrogen in the soil, as well as a high percentage of the other essential plant nutrients supplied by the soil (Millar, et al. 1965:204-5,383). During the processes of building roads and staging areas, and excavating for tower and substation foundations, the A horizon is usually either removed from the site or mixed and diluted with other soil to the point that its beneficial qualities are lost. On access roads where the A horizon has not been removed by construction, it would be the first soil layer lost through erosion. In either case, the loss of the A horizon represents a substantial decrease in soil fertility and a corresponding loss in productivity.

A decrease in soil fertility would also occur as a result of increased leaching of soil nutrients, although the decrease would be less substantial than that due to erosion. This impact would occur primarily where the soil is not drastically disturbed but where forest vegetation is removed and prohibited from reestablishing itself, such where the right-of-way is cleared but not disturbed by road construction. Long-term removal of forest vegetation would result in decreased nutrient and water uptake by plants. More water and nutrients would, therefore, be available for leaching, thus increasing the rate of leaching. Concerning removal of forest vegetation and subsequent prevention of reforestation, extensive research indicates that "This accelerated rate of nutrient loss was related to the decreased uptake of nutrients by plants and to greater quantities of drainage water flowing through the system" (Kitchings, et al. 1974:14).

CORRIDOR COMPARISONS

The twenty-nine Step 3 corridor segments are compared for water erosion hazard, susceptibility to soil mass movement, land suitability, and the land suitability impact score in Table VII-1. The land suitability rating is an overall rating which includes water erosion hazard and susceptibility to soil mass movement as well as other hazards (see "Land Suitability," Chapter IV). The land suitability impact score is the sum of the products of miles in each suitability class and their respective weights (see Figure VII-1). The other ratings are interpretations from Land Suitability Pattern for Electrical Transmission Lines (USDA Forest Service, 1976a).

The Applicant's proposed corridor and the seven alternatives can be compared for the above items using Table VII-2, which summarizes appropriate corridor segment scores from Table VII-1.

SURFACE WATER

DISCUSSION

If the transmission lines are built, the most significant impact on surface water systems would be an increase in sediment and a corresponding increase in turbidity. Increases in sediment and turbidity would be inevitable to some degree in all surface waters crossed by the transmission lines, and would be of greatest magnitude within the first two years of construction. They would persist to a lesser degree as long as the corridor and access roads are maintained.

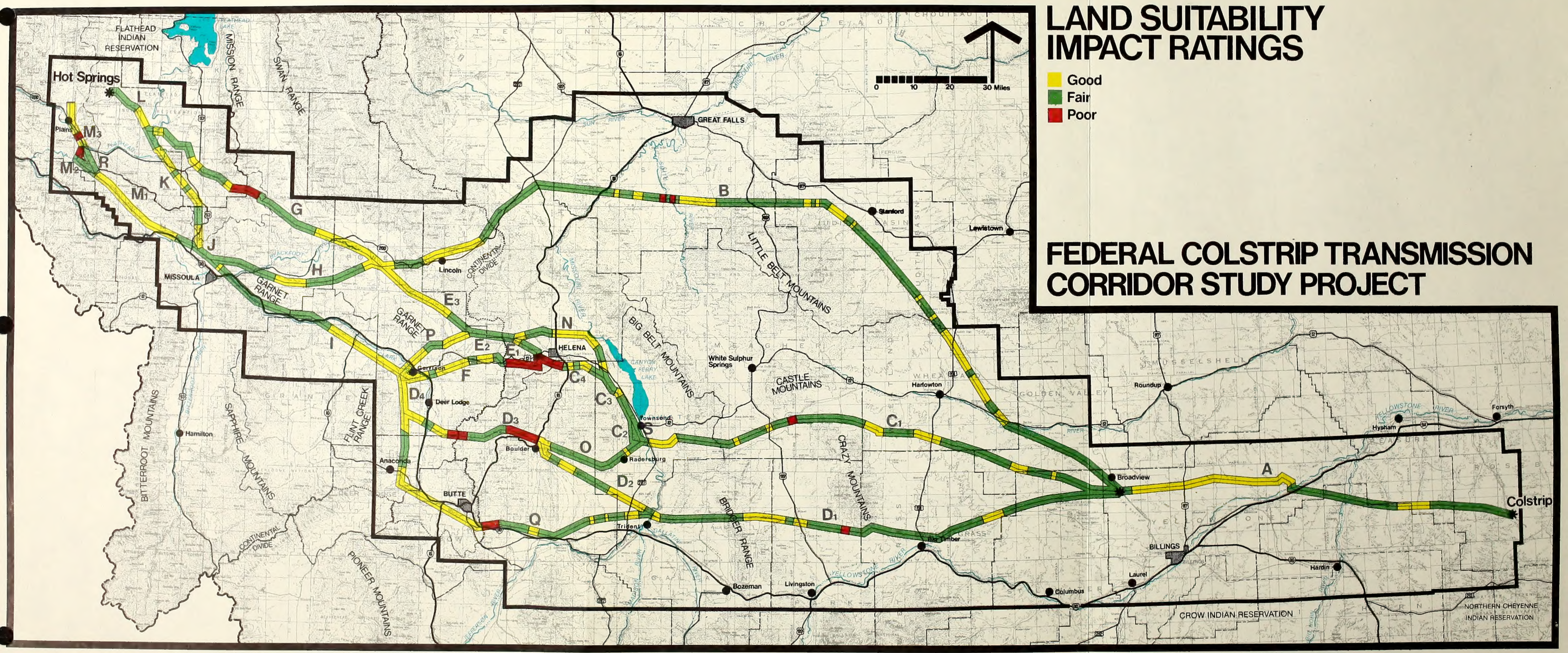
Table VII-1 - SOIL IMPACTS

CORRIDOR SEGMENT	LENGTH (in miles)	LAND SUITABILITY (miles)			WATER EROSION HAZARD FOR COMPACTED SOILS (miles)			SUSCEPTIBILITY TO SOIL MASS MOVEMENT (miles)		LAND SUITABILITY IMPACT SCORE*
		GOOD	FAIR	POOR	LOW	MODERATE	HIGH	MODERATE	HIGH	
A	111.4	55.5	55.9	-	10.5	100.9	-	-	-	167
B	241.8	105.8	133.0	3.0	48.3	190.5	3.0	-	-	384
C_1	134.2	32.9	99.1	2.2	7.7	124.3	2.2	-	-	241
C_2	7.0	-	7.0	-	-	7.0	-	-	-	14
C_3	13.2	5.0	8.2	-	-	13.2	-	-	-	21
C_4	20.1	4.1	8.0	8.0	-	12.1	8.0	-	-	52
D_1	130.7	34.3	95.4	1.0	2.3	128.4	-	-	1.0	229
D_2	35.7	21.3	14.4	-	1.8	33.9	-	-	-	50
D_3	39.2	12.3	15.3	11.6	2.8	24.8	11.6	12.5	-	89
D_4	10.7	10.7	-	-	-	10.7	-	-	-	11
E_1	8.3	1.4	6.9	-	-	8.3	-	-	-	15
E_2	11.2	0.3	10.9	-	7.9	3.3	-	-	-	22
E_3	32.5	22.9	9.6	-	18.1	14.4	-	9.0	-	42
F	42.7	22.5	9.3	10.9	4.2	27.6	10.9	6.6	-	85
G	78.3	35.7	35.5	7.1	36.4	41.9	-	7.1	-	135
H	48.5	13.4	35.1	-	45.7	2.8	-	-	-	84
I	61.2	24.0	37.2	-	36.1	25.1	-	-	-	98
J	4.7	-	4.7	-	-	4.7	-	-	-	9
K	35.7	20.1	15.6	-	32.9	2.8	-	2.6	-	51
L	16.1	4.6	11.5	-	8.7	7.4	-	-	-	28
M_1	36.6	29.6	7.0	-	15.5	21.1	-	-	-	44
M_2	9.3	-	6.5	2.8	6.5	2.8	-	2.8	-	24
M_3	11.3	9.7	-	1.6	9.7	1.6	-	1.6	-	16
N	32.2	20.8	11.4	-	-	32.2	-	-	-	44
O	30.0	4.5	25.5	-	-	30.0	-	-	-	56
P	23.6	11.5	12.1	-	6.6	17.0	-	1.6	-	36
Q	90.7	43.6	42.5	4.6	16.3	69.8	4.6	8.0	-	147
R	8.3	2.1	2.8	3.4	5.1	3.2	-	3.2	-	21
S	6.0	-	6.0	-	-	6.0	-	-	-	12

* Not multiplied by determinant value of 2.

Table VII-2 - SOIL IMPACTS

CORRIDORS	LENGTH (in miles)	LAND SUITABILITY (miles)			WATER EROSION HAZARD FOR COMPACTED SOILS (miles)			SUSCEPTIBILITY TO SOIL MASS MOVEMENT (miles)		LAND SUITABILITY IMPACT SCORE
		GOOD	FAIR	POOR	LOW	MODERATE	SEVERE	MODERATE	HIGH	
APPLICANT'S PROPOSED	431.3	162.4	251.6	17.3	89.3	331.8	10.2	16.1	-	735
SIEGEL PASS	446.3	176.9	254.2	15.2	120.2	315.9	10.2	13.8	-	746
GREAT FALLS	447.6	201.6	235.9	10.1	103.9	340.7	3.0	7.1	-	714
HELENA (MACDONALD PASS)	445.3	168.7	255.5	21.1	100.1	324.1	21.1	9.2	-	764
HELENA (AVON VALLEY)	445.7	159.4	276.1	10.2	110.4	325.1	10.2	4.2	-	752
TOWNSEND-BOULDER	443.2	164.6	264.8	13.8	98.7	330.7	13.8	15.1	-	750
TRIDENT-BOULDER	445.4	182.8	250.0	12.6	95.1	338.7	11.6	15.1	1.0	732
BUTTE-ANACONDA	461.2	192.8	262.8	5.6	106.8	349.8	4.6	10.6	1.0	740



LAND SUITABILITY IMPACT RATINGS

- 🟨 Good
- 🟩 Fair
- 🟥 Poor

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure VII-1

Other impacts on surface water would be: increases in water yield, dissolved solids, and, possibly, water temperature. These impacts would be of small magnitude and less significant than the increase in sediment.

Potential water yield, dissolved solids, and temperature increases would result primarily from elimination of forest vegetation. Consequently, they would occur only on the forested portions of the corridor. Although of small magnitude, increases in water yield and dissolved solids would have a high probability of occurrence. Temperature increases are somewhat less probable as they would depend upon the extent of clearing immediately adjacent to the stream. These impacts would continue as long as regrowth of forest vegetation is prevented.

Contamination by herbicides could be a potential impact, but since the applicant has stated that, "Herbicides will not be used during construction or maintenance of this line," (WESD/AEA 1973:3-81) it is considered irrelevant, except for the BPA-Build Alternative, as discussed later in this chapter.

Most of the increase in sediment would be associated with construction and maintenance of access roads. Activity at other construction sites (tower footings, staging areas, communication and control facilities, etc.) would also produce sediment, but would disturb much less total area. Depending on topography, access roads could be expected to disturb an area from 25 to 60 feet wide. The length of new access roads would vary from 0.4 to 1.6 miles of road per mile of corridor, depending upon topography and existing rights-of-way (WESD/AEA 1973:3-92). In addition to the area actually disturbed by construction, roads often trigger soil mass movements, thus further increasing the size of the sediment producing area (U.S. Environmental Protection Agency 1975:54; Swanston 1971).

Extensive research on logging activities has shown that roads are the primary sources of sediment from forest lands, where the amount of sediment contributed by roads can be consequential. Megahan (1972) found that, "Sediment produced by surface erosion from roads (expressed per unit of area disturbed by road construction) averaged 220 times as great as yields produced from nearby undisturbed lands for the same study period; mass erosion from roads (expressed in similar units) averaged 550 times as great." Packer (1967) cites his own research and nine other references when stating that "Observations and records indicate that most sediment from forest lands that reaches stream channels originates on logging roads." The U.S. Environmental Protection Agency (1975:53-54) cites additional research when stating that "There is considerable evidence that logging roads are the primary source of accelerated erosion and sedimentation caused by silviculture activities."

Increases in sediment due to access roads, though insignificant in all watersheds, would be the most detrimental in forested watersheds because the existing water quality is highest in these areas. As previously discussed, sediment yields from building and construction sites are much higher than from other land uses.

Of the total amount of sediment produced during the life of the access roads, by far the largest percentage (perhaps as much as 50 to 90 percent) would be produced within the first two years of construction (Megahan 1972, 1974; U.S. Environmental Protection Agency, 1975:57). The sediment production rate begins to decrease as vegetation reestablishes itself and as the coarse fragments which are left behind after initial erosion form a protective "armor plating" or erosion pavement.

The rate of sediment production is dependent upon soil erodibility, stream channel density, and slope characteristics. Using these factors, the USDA Forest Service (1976a) has assigned a sediment risk rating to each of the mapping units on the Land Suitability Map (Figure III-6). Their ratings of low, moderate, and severe, have been changed to low, medium, and high, respectively, in this report.

A low rating means that increased sediment production could be controlled by normally used practices, such as waterbars, filter strips, and cross drains, with no special treatment required. A medium rating indicates that special measures which are costly to apply, such as culverts or mulch, would be required to control erosion. A high rating indicates that the number and kind of practices needed, such as sediment basins and road surfacing, would make construction very costly, and that even with these practices, satisfactory control of sediment may be impossible.

The sediment risk ratings for the suitability mapping units which are crossed by transmission corridors are as follows (see Figure VII-2):

Ratings	Mapping Units
low	A_2, B_1, B_2, B_3, B_4, F_3,F_4, F_6, M_2, M_3, M_4 M_7, M_9, M_{13}, M_{14}, M_{25}, P_1, P_4, P_5
medium	F_1 F_2, F_5, F_7, M_1, M_{12}, M_{18}, M_{20} P_2, P_6, P_7
high	M_8, P_3

The Suitability Map (Figure III-6) does not cover the Colstrip to Broadview portion of the line. However, using maps of soils, topography, and precipitation, sediment risk ratings have been assigned to this portion. Sediment risk is medium between Colstrip and the Yellowstone River except for a few miles along Sarpy Creek where it is low. Sediment risk is also low between the Yellowstone River and Broadview.

Where it would be necessary to remove forest vegetation within a corridor (see the "Vegetation" section of this chapter), surface water would also be impacted by increases in water yield, dissolved solids (nutrients), and temperature. These impacts would not likely be of large magnitude and would not be as significant or detrimental as increases in sediment.

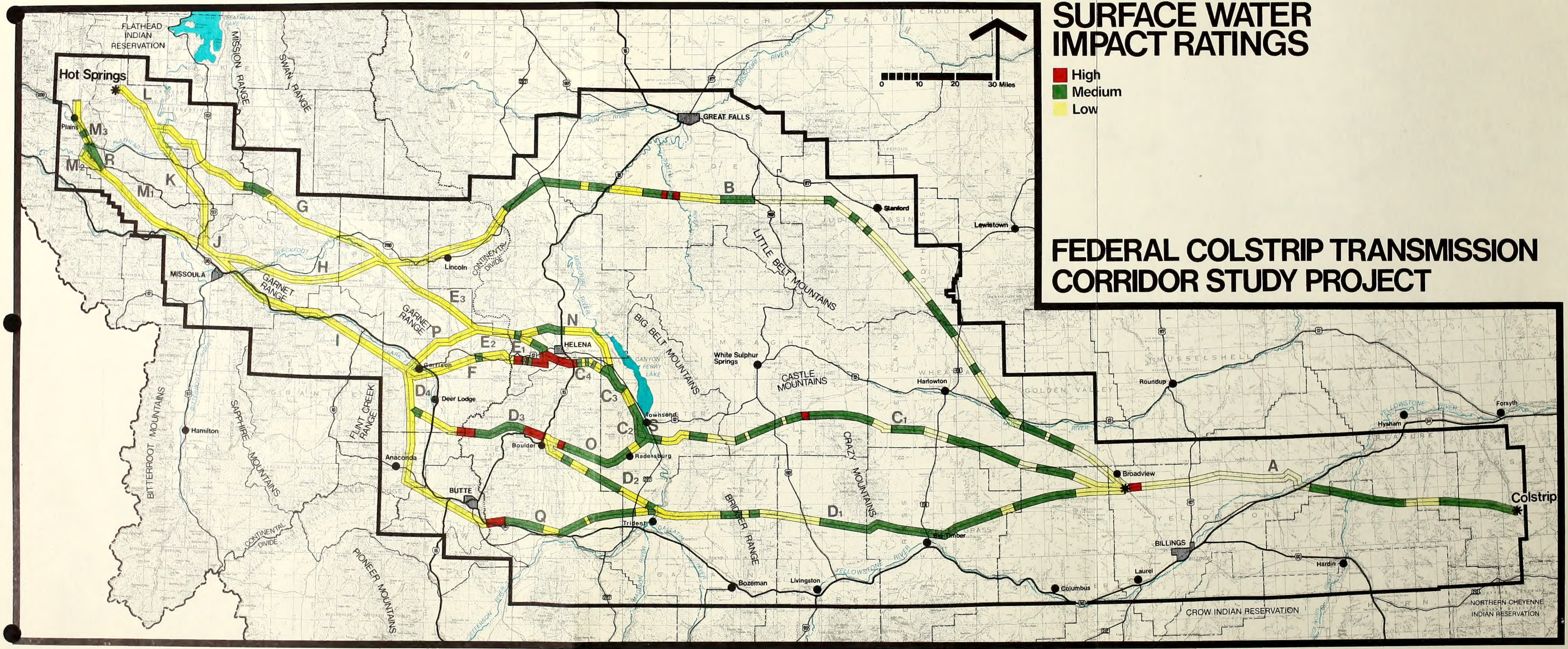
Numerous research projects have shown that cutting forest vegetation increases water yield. Research in Colorado, West Virginia, North Carolina, Oregon, and California has verified that removal of forest vegetation increases streamflow (USDA Forest Service 1973a:2-3).

Research conducted on the Hubbard Brook Experimental Forest in New Hampshire, where the average annual precipitation exceeds that of the study area by about 26 inches, shows that clearing an entire 39-acre watershed (without constructing any roads) increased annual water yield an average of 12.2 acre-inches (Hornbeck, et al. 1970). In another study on the same forest, one third of a watershed is being harvested every other year by cutting a series of 80-foot wide strips. Streamflow increased by an average of 1.3 inches per year following the cutting of the first one-third of the watershed (Hornbeck and Federer 1975).

As a matter of perspective, it is highly doubtful that more than five percent of any second order watershed would be cleared by construction of the transmission lines, using a "worst case" clearing width of 300 feet for the longest axis of the watershed. The average annual water yield for most of these watersheds is probably within the range of 1 to 30 acre-inches, depending upon annual rainfall, soil water holding capacity, and other watershed characteristics. Therefore, the impact of the transmission line corridor on water yield would not be of large magnitude. However, such impacts, combined with similar impacts from other probable land management activities such as highway construction, timber harvest or pipeline corridor construction, can be highly significant. Since such combined impacts result from unrelated projects, they may never be addressed in total. Consequently, the potential of impacts to combine synergistically must be considered on an individual basis.

The duration of increases in water yield is quite variable, as it is related to the amount of time needed for vegetation to reestablish itself. The primary reason for increases is that fewer trees are available to utilize soil water so that a larger amount of water reaches the stream. Stream flows would return to normal after vegetation begins to use as much water as it did prior to the removal of trees. At Hubbard Brook, re-attaining this level this has been estimated to require three or four years (Hornbeck and Federer 1975); it would probably take longer in the Colstrip study area because the predominance of conifers (as opposed to broad-leaved trees), the climatic differences, and the slower vegetative regeneration rates here could prolong the recovery time for many years.

Removal of forest vegetation would also cause small increases in dissolved solids and may cause slight increases in surface water temperature (Kitchings, et al. 1974:22-31).



SURFACE WATER IMPACT RATINGS

🟥 High
🟩 Medium
🟨 Low

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure VII-2

Dissolved solids (nutrients) reach surface water through leaching and soil erosion. Since there would be less vegetation to utilize nutrients, more nutrients would be available for leaching and erosional losses. The Hubbard Brook experiments, for example, showed increases in nutrient ions -- especially nitrate -- in surface water following clearcutting of a watershed (Pierce, et al. 1970). Cutting a series of strips within the watershed also produced increases, but they were of less magnitude. Nitrate content was 11 parts per million following strip-cutting -- well within drinking water standards (Hornbeck and Federer 1975).

Increases in stream temperature would depend upon the number of trees removed immediately adjacent to the stream. Direct sunlight on the stream channel increases stream temperatures. If a shading strip of trees were left along the stream channel, temperature increases would probably be held to less than 2^{o} F (Hornbeck and Federer 1975).

FLOODPLAINS

Executive Order 11988, May 1977, requires that "Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains . . ." The Order defines floodplains as those areas "subject to a one percent or greater chance of flooding in any given year."

The construction of transmission lines from Colstrip to Hot Springs would, of necessity, cross floodplains. There is no reasonable and practical alternative to get from Colstrip to Hot Springs without crossing the floodplains of streams such as the Yellowstone, Missouri, and Flathead Rivers.

Floodplain maps are available for only a few parts of the study area. However, the Suitability Map (Figure III-6) contains a mapping unit (A_2) composed of floodplains. Therefore, the hazards of constructing the transmission line on floodplains and those from construction on other kinds of land (mountains, foothills, etc.) have been kept in perspective during corridor evaluation.

In order "to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare . . ." this report recommends that transmission towers be located out of the floodplains in attempts to span them and that, where this is not possible, towers located in floodplains be constructed to withstand a 100-year flood.

Natural and beneficial values of floodplains were considered, in this analysis, as parts of the resources within which those values occur. For example, floodplains which are valuable to waterfowl were evaluated under the Fish and Wildlife determinant (Chapter IV) and floodplains which are valuable to agriculture were evaluated under the Agricultural Land determinant (Chapter IV).

CORRIDOR COMPARISONS

The twenty-nine Step 3 corridor segments are compared for total number of water bodies crossed, sediment risk, wetlands crossed, "A" classified streams crossed (MDHES 1974), and surface water impact score in Table VII-3. Total number of water bodies crossed was determined from USGS 1:250,000 topographic maps. Sediment risk was taken from Land Suitability Pattern for Electrical Transmission Lines (USDA Forest Service 1976a). The determination of wetlands is described in the "Wetlands" section of this chapter. "A" classified streams are identified in the Montana Water Quality Standards (MDHES 1974).

The surface water impact scores are the sums of the products of miles crossed of wetlands and each sediment risk category, and their respective weights (see Chapter IV; Figure VII-2).

Table VII-3 - SURFACE WATER IMPACTS

CORRIDOR SEGMENT	LENGTH (in miles)	TOTAL NUMBER OF WATER BODIES CROSSED*	SEDIMENT RISK (Miles)			WETLANDS CROSSED (Miles)	SURFACE WATER IMPACT SCORE
			HIGH	MEDIUM	LOW		
A	111.4	59		45.8	65.6	2.8	168
B	241.8	155	3.0	107.0	131.8	-	358
C_1	134.2	56	2.2	92.7	39.3	-	234
C_2	7.0	0	-	7.0	-	-	14
C_3	13.2	5	-	8.2	5.0	-	21
C_4	20.1	4	8.0	8.0	4.1	-	52
D_1	130.7	72	-	91.0	39.7	-	222
D_2	35.7	17	-	12.6	23.1	-	48
D_3	39.2	14	11.6	12.5	15.1	-	86
D_4	10.7	7	-	-	10.7	-	11
E_1	8.3	3	-	6.9	1.4	-	15
E_2	11.2	3	-	3.0	8.2	-	14
E_3	32.5	10	-	-	32.5	-	33
F	42.7	11	10.9	3.2	28.6	-	79
G	78.3	38	-	7.1	71.2	-	85
H	48.5	15	-	-	48.5	-	49
I	61.2	26	-	-	61.2	-	61
J	4.7	2	-	-	4.7	-	5
K	35.7	21	-	-	35.7	-	36
L	16.1	9	-	-	16.1	-	16
M_1	36.6	33	-	-	36.6	-	37
M_2	9.3	7	-	2.8	6.5	-	12
M_3	11.3	4	-	1.6	9.7	-	13
N	32.2	12	-	12.0	20.2	-	44
O	30.0	14	0.6	25.0	4.4	-	57
P	23.6	7	-	-	23.6	-	24
Q	90.7	35	4.6	30.3	55.8	-	135
R	8.3	1	-	3.2	5.1	-	12
S	6.0	0	-	6.0	-	-	12

* From USGS 1:250,000 Topographic Maps

The Applicant's proposed corridor and the seven alternatives are compared for the above items in Table VII-4, which summarizes the appropriate corridor segment scores from Table VII-3.

Table VII-4 SURFACE WATER IMPACTS

CORRIDORS	LENGTH (in miles)	TOTAL NUMBER OF WATER BODIES CROSSED*	SEDIMENT RISK (miles)			WETLANDS (miles)	SURFACE WATER IMPACT SCORE
			LOW	MEDIUM	HIGH		
APPLICANT'S PROPOSED	431.3	187	10.2	117.7	243.4	2.8	651
SIEGEL PASS	446.3	195	10.2	175.4	260.7	2.8	665
GREAT FALLS	447.6	261	3.0	159.9	284.7	2.8	627
HELENA (MACDONALD PASS)	445.3	193	21.1	163.9	260.3	2.8	684
HELENA (AVON VALLEY)	445.7	195	10.2	170.6	264.9	2.8	658
TOWNSEND-BOULDER	443.2	208	14.4	176.0	252.8	2.8	674
TRIDENT-BOULDER	445.4	227	11.6	161.9	271.9	2.8	653
BUTTE-ANACONDA	461.2	231	4.6	167.1	289.5	2.8	654

* from USGS 1:250,000 Quads.

VEGETATION

DISCUSSION

The vegetative cover of the study area would have a high probability of being impacted by the introduction of power transmission facilities. Consequently, a composite vegetative cover category was developed for impact analysis purposes (see the "Vegetative Cover" discussion in Chapter IV). This category is composed of agricultural land, rangeland, forest land, threatened and endangered species and wetlands. Figure VII-3 presents the corridor impact ratings for vegetative cover, as based on the following rationale:

1. Agricultural land represents an already disturbed vegetation situation. It is a highly managed vegetation system and vegetative recovery would represent a minor problem. Therefore, since impacts on agricultural vegetative cover would not be very serious, it was assigned a low rating.

2. Rangeland vegetation is more sensitive to disruption of its natural condition and has related recoverability problems, so it was rated medium for seriousness of impact.

3. Forest land vegetation would be completely changed in most of the entire right-of-way for as long as the corridor would be maintained in service, so its sensitivity or seriousness rating is high.

4. Likewise, any threatened or endangered plant species or wetlands vegetation would be seriously impacted if disrupted by activities related to a power transmission corridor, so they were also rated high.

Rangeland

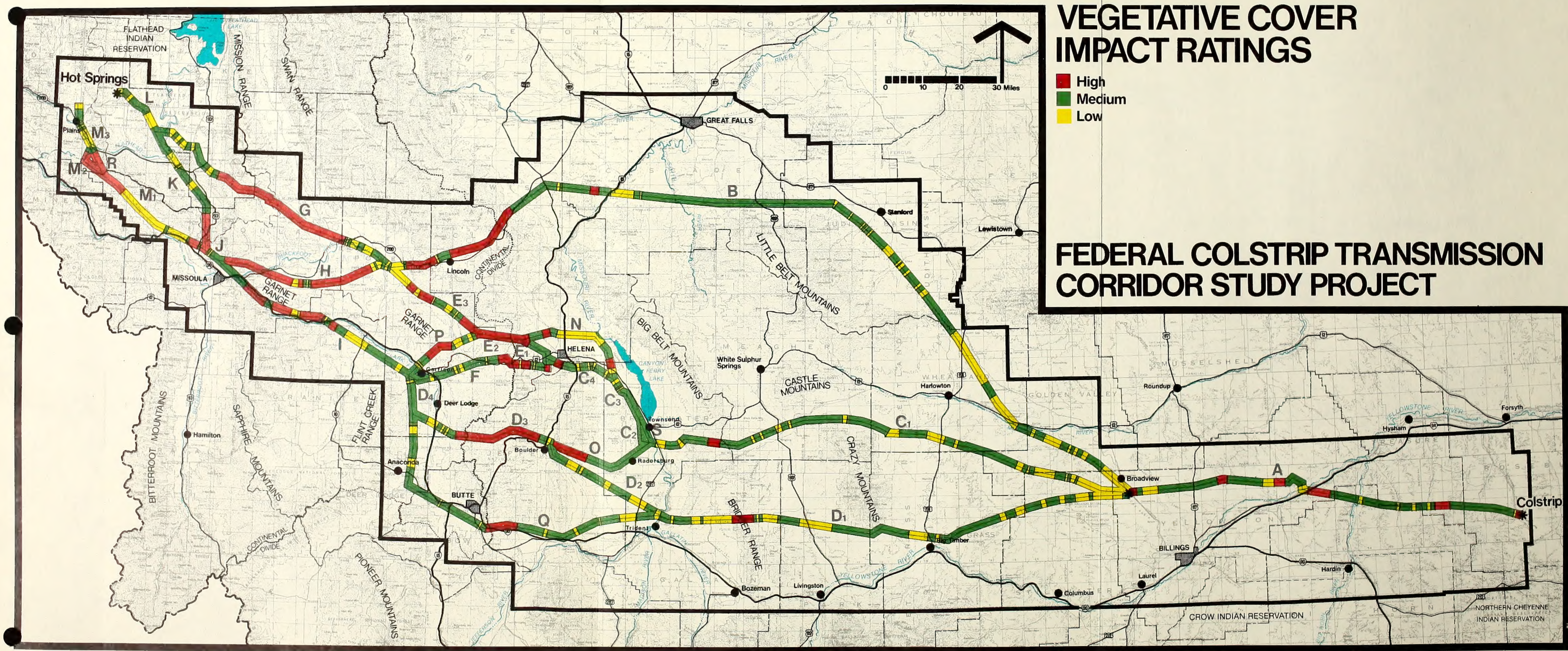
Construction and maintenance along any of the transmission corridors, would entail various actions which would result in removal of vegetative cover. These include clearing for access roads, tower sites, skid trails, stringing and tensioning pads, and communication facilities. The complete but localized destruction of vegetation from these earthmoving activities is considered significant in evaluating recovery rate.

Table VII-5 shows the estimated miles of construction, acreage of vegetative cover that would be removed during the construction phase, and the number of acres removed from production for the life of the project within each vegetative community, for both the proposed and alternative corridors. Construction phase impacts on understory vegetation would, for the most part, be temporary. The period of time required for revegetation by natural processes or by seeding varies widely between sites, depending on precipitation, growing season, soil type, aspect, and past and future use of the area. However, understory recovery should occur in three to eight years except on extremely dry, unproductive sites. Unproductive sites are essentially barren at present and constitute a relatively small portion of the total study area. Hence, any disturbance on such sites would be negligible.

The number of acres disturbed by construction activities and the number removed from forage production for the life of the project were estimated using several factors. These include: the percent side-slope and ruggedness of terrain traversed by access roads, which influence road width construction requirements; and the access road length, which would also be greater, per mile of line, in mountainous areas than in the flatter eastern half of the state.

Vegetative cover lost for tower installations was also taken into account. As the Applicant proposes to construct the towers for the two parallel transmission lines opposite one another, about one-half acre of vegetative cover per paired tower site would be disturbed. From the Bonneville Power Administration's previous power line construction experience, five towers per mile have been found to be the average, regardless of terrain. Therefore, 2.5 acres per mile would be impacted by tower construction (see Table VII-5).

Long-term impacts on rangeland productivity depend in part on whether access roads would be left open and untreated, or seeded, mulched, and protected for several years. If temporary access roads are abandoned without being treated, the finer soil particles quickly erode away and nutrients leach rapidly, often to levels below plant rooting depths, causing long-term site deterioration. In scarified areas such as roads, abiotic environmental factors largely determine post construction species composition and coverage. Plant species capable of becoming



VEGETATIVE COVER IMPACT RATINGS

- 🟥 High
- 🟩 Medium
- 🟨 Low

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure VII-3

established on disturbed sites (e.g., Russian thistle) often have poor forage value. Poisonous or noxious plants (see Table III-3) might also become established in disturbed areas. Control of such plants should be under the direction of local weed control districts. Also, site deterioration is accelerated and recovery retarded by vehicular use, whether by maintenance crews or the general public. Roads that are not closed and revegetated can be considered long-term productivity losses.

Table VII-5 shows the number of acres lost from production for three to eight years following construction within each vegetative community, for the proposed and alternative corridors. These values (termed "acres disturbed by construction") are the product of the total acres per mile impacted by construction activities and the miles of each vegetative community crossed by each corridor. Total acres impacted per mile of line was derived, depending on the percent sideslope, by multiplying the number of acres per mile for access roads by the actual access road length per mile, and then adding the acres per mile disturbed during tower construction using the following data:

SIDESLOPE(%)	ACCESS ROAD WIDTH (feet)	ACRES/MILE FOR ACCESS ROADS	ACTUAL ROAD LENGTH PER MILE OF LINE	ACRES/MILE FOR TOWER CONSTRUCTION	TOTAL IMPACT (acres/mile)
17	25'	3.03	1.1	2.5	5.8
18-34	32'	3.88	1.6	2.5	8.6
34	60'	7.27	1.6	2.5	14.1

Those vegetative communities that would require access road construction on sideslopes exceeding 35 percent along a significant length of corridor are the western larch-Douglas fir, lodgepole pine-Douglas fir, and western Montana ponderosa pine communities. The foothill sagebrush, eastern Montana ponderosa pine, and the beartooth juniper-limber pine communities would require road construction on sideslopes between 18 and 34 percent for most of a corridor's length. The remaining communities would seldom require construction on sideslopes exceeding 17 percent. Miles of each vegetative community was crossed by each corridor were derived from Figure III-8.

Projected acres of vegetation that would remain out of livestock forage production for the life of the project (Table VII-5) assume a 16-foot wide maintained access road. Such a road would withhold 1.94 acres of vegetation from production per mile, which was multiplied by the actual access road length per mile, as described above. As livestock and other herbivores can graze within the self-supporting tower base, and as the footings on both the self-supporting and guyed towers constitute only a few square feet per tower, the long-term impact of towers on available forage was not considered significant enough to be computed.

The number of livestock animal unit months (AUMs) lost during the year of construction (assuming construction starts in the spring prior to livestock being turned out on the range) and for each year of the recovery period, and the number of AUMs lost each year throughout the life of the project were derived by dividing the acreage estimates in Table VII-5 by the existing carrying capacity for each vegetative community. These AUM loss estimates are displayed in Table VII-6.

Constructing the Siegel Pass alternative would impact significantly more acreage than the other potential routes, primarily because of the greater access road width and length required due to the steeper topography (Table VII-5). Conversely, the Siegel Pass alternative would cause the least reduction in livestock carrying capacity because it traverses more low livestock forage-producing forest vegetative types.

It is possible that more AUMs would be made available along timbered vegetation types on all corridors because tree removal for the transmission line would open up the understory. No attempt was made to quantify any increases in AUMs because of the many variables involved.

Table VII-6 - VEGETATION LOSS IMPACTS BY CORRIDOR SEGMENT

		VEGETATIVE COMMUNITIES															
CORRIDORS	LENGTH (in miles)	WESTERN LARCH-DOUGLAS FIR	LODGEPOLE PINE-DOUGLAS FIR	WESTERN MONTANA PONDEROSA PINE	INTERMOUNTAIN VALLEY GRASSLAND & MEADOW	FOOTHILL SAGEBRUSH	FOOTHILL GRASSLAND	NORTHERN GRASSLAND	TETON RIVER-JUDITH BASIN GRASSLAND	CENTRAL GRASSLAND	EASTERN MONTANA PONDEROSA PINE	BEARTOOTH JUNIPER-LIMBER PINE	PONDEROSA PINE SAVANNAH	RIPARIAN	SANDY GRASSLANDS	TOTAL
APPLICANT'S PROPOSED	431.3	* 4	62	57	243	10	178	0	48	150	45	5	48	13	14	877
		** 1	14	13	89	3	65	0	18	55	16	2	18	5	5	304
SIEGEL PASS	446.3	* 14	46	187	111	10	178	0	48	150	45	5	48	13	14	869
		** 3	10	41	41	3	65	0	18	55	16	2	18	5	5	282
GREAT FALLS	447.6	* 4	37	144	194	0	116	28	137	147	45	0	48	15	1	916
		** 1	8	32	71	0	42	10	50	54	16	0	18	5	0	307
HELENA (MACDONALD PASS)	445.3	* 0	78	30	326	10	167	0	48	150	45	5	48	13	14	934
		** 0	17	7	129	3	61	0	18	55	16	2	18	5	5	336
HELENA (AVON VALLEY)	445.7	* 0	56	61	315	10	178	0	48	150	45	5	48	13	7	936
		** 0	12	13	116	3	65	0	18	55	16	2	18	5	3	326
TOWNSEND-BOULDER	445.2	* 0	100	30	355	15	105	8	52	150	45	2	48	13	7	930
		** 0	22	7	103	5	39	3	19	55	16	1	18	5	3	296
TRIDENT-BOULDER	445.4	* 0	70	30	343	9	148	15	43	129	93	2	48	11	5	946
		** 0	15	7	126	3	54	6	16	47	33	1	18	4	2	332
BUTTE-ANACONDA	461.2	* 0	52	30	420	21	148	0	49	129	93	3	48	11	5	1009
		** 0	11	7	154	7	54	0	18	47	33	1	18	4	2	356
Existing Estimated Carrying Capacity (a/AUM)		32.0	8.0	5.0	2.0	5.0	3.0	4.5	3.0	3.5	3.5	10.0	4.0	3.0	5.5	

* AUM's temporarily lost each year during construction and recovery period.

** AUM's lost each year for the project life.

In some cases, non-palatable species such as dwarf huckleberry or beargrass would dominate the site providing no increased forage productivity. Similarly if livestock were excluded from grazing a certain area by, for example, divergent management objectives, any additional production increases could not be utilized by livestock. Also, some of the steeper mountainous areas may not be accessible to livestock, even should more forage become available. Increased productivity in areas unavailable to livestock would undoubtedly increase the carrying capacity for some wildlife species, however.

It may be assumed that any such overall forage increases that could be utilized by livestock would be minimal and probably about the same for all corridors. Therefore, for corridor comparative purposes, forage increases due to construction were not taken into account.

A right-of-way finally selected would need to be periodically maintained to remove trees and understory vegetation that could present a transmission line hazard or impede maintenance vehicle travel. Consequently, periodic short-term productivity losses due to maintenance activities would result. These losses would most likely offset any forage increases from construction in timbered areas.

The understory vegetation recovery period would vary between 3 and 8 years. In order to make a comparison between corridors, the AUMs lost each year of the recovery period are multiplied by the average recovery period of 5 years (Table VII-7).

Because any corridor, once selected, would probably continue to be used as a utility corridor even beyond the projected 50-year life of this project, it would seem impractical to project the total AUMs that would be removed from future production that can be directly attributed only to this particular project. Regardless of the corridor route selected, approximately 300 AUMs would be removed from livestock use each year after the recovery period (see Table VII-6). In other words, there would be very little difference in lost productivity, no matter which corridor might be selected.

Table VII-7 - ANIMAL UNIT MONTHS LOST DUE TO CONSTRUCTION

CORRIDOR	AUMS LOST/YR OF RECOVERY PERIOD	AUMS LOST DURING AVERAGE RECOVERY PERIOD (5 yrs.)
APPLICANT'S PROPOSED	877	4,385
SIEGEL PASS	869	4,345
GREAT FALLS	916	4,580
HELENA (MACDONALD PASS)	934	4,670
HELENA (AVON VALLEY)	936	4,680
TOWNSEND-BOULDER	930	4,650
TRIDENT-BOULDER	946	4,730
BUTTE-ANACONDA	1009	5,045

The construction phase could result in some relatively minor disruptions of grazing patterns. Domestic stock adjust rapidly to human activity. No major changes in grazing patterns have been observed on existing Bonneville Power Administration transmission line corridors due to operation and maintenance activities. However, cattle tend to move along trails and roads; therefore, some change in grazing patterns would be likely, with one result being better livestock distribution in previously less accessible areas.

Only a few studies have been conducted to determine if electric fields or other parameters of transmission lines affect animals in natural environments. Based on a study in Indiana on a 765-kV transmission line, it was concluded that livestock seemed to graze under such lines without concern. Another study by Goodwin (1975) noted no adverse effects on wildlife which could be attributed to the electric field or noise produced by a 500-kV transmission line (BPA 1977).

Construction activities could also impact existing range improvements such as fences, cattleguards, and gates. Gates left open by construction crews or the public could potentially cause some livestock distribution problems, although these problems could be easily mitigated.

Increased activity because of vehicular access on the new right-of-way and access roads would increase the chance of man-caused fires; conversely, improved vehicle access could be an aid to fire suppression efforts.

Fugitive dust during the construction phase and from vehicles traveling the access roads after construction would have some effect on nearby vegetation. If the leaves of roadside plants become coated with dust, the photosynthetic process may be curtailed enough to cause plant growth retardation or death.

Off-road vehicle use has become a popular form of recreation, and in all likelihood the corridor selected would traverse areas which previously were relatively inaccessible. Therefore, if the access roads are left open, new roads or trails could become established off the main access road, causing further vegetative losses.

Clearing extensive areas along a corridor can open up these sites to exotic species and blight. The spread of fungi, insects, and undesirable species of plants along the corridor could, in some instances, be significant. Bark beetles and grasshoppers are among the pests that can spread rapidly through cleared areas. Vegetation losses due to plant diseases, increased insect populations, and the invasion of unpalatable plant species would further reduce livestock forage.

Indirect impacts can also occur when transmission line corridors are established. For example, if vegetation is removed, microenvironmental changes involving soil temperature, solar radiation, snow accumulation or melt, wind patterns, frost pockets or a variety of other factors can either singly or cumulatively influence the types of plant species capable of reestablishing on the impacted area. Another significant indirect impact is the potential acceleration of soil erosion on steep slopes. Surface runoff increases could occur because of the lowered infiltration rate of the soil and lack of humus to hold moisture. Wildlife population dynamics could also be indirectly affected by changes in food and cover. The magnitude of these indirect impacts is dependent on such factors as the amount and type of vegetation removed, aspect and slope, time of year, method of vegetative removal and rehabilitation methods.

Certain plant species are considered threatened or endangered for various reasons, including low adaptability, restricted habitat, or lack of tolerance to disturbance. If any threatened or endangered species are found along the corridor selected, the area must be avoided if, after consultation with a local Fish and Wildlife Service representative, the habitat is considered critical. Threatened and endangered flora which may occur in the study area are discussed under "Vegetation," Chapter III.

Constructing new communication sites and substations or upgrading existing facilities would cause further vegetative removal. New substation facilities would each require about three acres. A communication site would require no more than a quarter acre if no new access roads are needed. Communication facilities, by necessity, are usually built on or near the tops of mountains, sites generally not suited for livestock grazing. Impacts from loss of this vegetation would be slight unless a rare or unique plant species were discovered in the immediate area.

Along part of each corridor analyzed, new construction would parallel existing transmission corridors and roads. Where new construction would be within approximately 1,400 feet of existing access, spur roads could be built as needed. At distances greater than 1,400 feet, new access roads would be necessary since construction of spur roads would disturb a larger area than would construction of new roads. Chapter V describes impact score adjustments used in the corridor analysis to account for existing rights-of-way.

Riparian areas would normally be avoided or spanned by the transmission line, however, short-term impacts could occur from construction equipment while erecting towers and stringing line. If a watercourse were not modified, any adverse impact to riparian vegetation would be temporary because of the rapid recoverability rate of this vegetative type.

In some areas requiring new access road construction, it might be necessary to establish borrow pits to obtain gravel for the roadbed. No acreage loss projection can be made at this time, although there would be some vegetative cover loss in areas with no existing quarries.

An accidental indirect adverse impact which can result from improper post-construction clean-up activities, particularly in grazing areas, is termed "hardware disease." Breakaway bolts and other small metal objects may remain on the ground after construction. Unless a thorough cleanup of the construction area is carried out, these metal items are likely to be ingested by ruminants and other grazing animals, often with fatal consequences if the metal pierces the digestive organs.

The experience of electric utility companies indicates that long-term exposure to electric fields at the levels that exist near U.S. transmission lines poses no hazard. No long-term effects on either plants or animals have been observed by Bonneville Power Administration in almost 40 years of operating more than 3000 miles of 500-kV or higher line (BPA 1977a).

Forest Land

The impacts of introducing a transmission line on forest lands were analyzed using the following criteria:

1. land removed from the timber acreage base;
2. productive capacity losses;
3. interference with timber management practices; and
4. recovery rate on disturbed sites.

Normally, the clearing for an ultra high-voltage transmission line would be of variable width and danger tree cutting would frequently be necessary especially in mountainous or hilly terrain. Such clearing adjustments depend upon slope, tree species, tree height, tree health, and wind-firm characteristics. Because these factors are determined in a centerline survey, the extent of these clearing adjustments cannot be predicted in this corridor study. Thus, for all corridors, clearing of the entire 300 foot wide right-of-way was assumed. This should compensate to some degree for not being able to predict where trees would be left in the right-of-way (as in deep draws that are spanned by the lines) and where danger trees would be cut outside the right-of-way.

In addition to clearing for the powerline right-of-way, approximately 60 percent of the access roads in mountainous country would be outside the right-of-way and would require clearing. As described under other impact discussions, the road clearing widths and the miles of road per mile of powerline vary with the sideslope:

SIDESLOPE(%)	ACCESS ROAD WIDTH*	ACTUAL ROAD LENGTH PER MILE OF LINE	ASSOCIATED FOREST COMMUNITIES
17	25'	1.1	Ponderosa Pine Savannah
18-34	32'	1.6	E. Ponderosa Pine
35	60'	1.6	W. Larch/Douglas Fir Lodgepole Pine/Douglas Fir W. Ponderosa Pine

*Includes road bed (14' - 16') and cuts and fills

Cleared areas would essentially be removed from timber management activities for the duration of the project, and the productive capacity in terms of commercial timber would be lost. The right-of-way would require 36 acres of land per mile of line, with an additional four to seven acres per mile of line for access roads outside the right-of-way in hilly and mountainous terrain. Losses in timber volume would be expected to be from 3,000 to 17,000 cubic feet per mile of road outside the powerline right-of-way. The gross acres and volumes affected by the introduction of a powerline and access roads are shown in Table VI-3, columns 6 & 7. Although some of the land removed from timber production may be converted to other uses, such as for cattle grazing or Christmas tree production, most would be converted to a noncommercial status.

Transmission lines can adversely affect forest management practices, such as the use of high lead (cable) logging. Locating transmission line towers on favorable terrain in mountainous areas, such as on ridge tops, may prohibit logging adjacent areas because of excessively increased logging and roading costs. This would be especially true in areas of steep and unstable slopes that would not normally be roaded for timber harvest operations.

Clearing of forests results in logging slash. Disposal of this slash is necessary to reduce fire hazard, eliminate a potential source of insect outbreak, and allow free movement of wildlife in and across the right-of-way. Disposal methods include piling and burning, chipping, or, in areas of very light concentrations, lopping and scattering the branches and tree tops. Burning would contribute to short-term air pollution.

Normally, grasses and forbs comprise the first vegetative cover established after a clearing operation. Left to natural processes, the sites would be invaded by forbs and grasses followed by shrubs, and would eventually again be dominated by trees. In the right-of-way, a stable nonforest-type vegetation is preferable to minimize this sucession and to reduce the frequency of vegetation control maintenance. Outside the right-of-way normal tree growth cycle should be permitted. New growth acquires stability and wind resistance and presents minimal danger to the transmission line. Future danger tree removal is then limited to those trees which either appear weak or unstable, or infringe on the required conductor clearance.

Wetlands

Executive Order 11990, May 1977, requires that "Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands . . ." The Executive Order further states, "This Order does not apply to the issuance by Federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on non-Federal property."

For the purposes of this study, wetlands were identified using USGS 1:250,000 topographic maps and US Department of Commerce Sectional Aeronautical Charts. The only wetland which is crossed by a corridor segment is an area southeast of Broadview crossed by Corridor Link A. Since this wetland is on non-Federal property, Executive Order 11990 is probably not applicable.

Soil surveys and field investigations indicate that the classification of the area southeast of Broadview as wetland is questionable. The Yellowstone County Soil Survey (USDA Soil Conservation Service, et al. 1972) has mapped the area as moderately well drained soil, and aerial reconnaissance indicates that the area has dryland rather than aquatic vegetation. The area is probably wet for only a short period of time following spring snow melt. The possible damage to the environment caused by construction of transmission lines in this area is therefore no more severe than the damage caused by construction in any other non-forested, nearly level area.

CORRIDOR COMPARISON

Rangeland

Table VII-8 displays the number of miles each corridor segment crosses the various vegetative communities as determined from Figure III-8, and the total impact rating for each corridor segment. The same impact ratings assigned to each vegetative type in the Step 1 analysis were used in Steps 2 and 3. It should be noted that the subalpine vegetative type considered in the Step 1 analysis was not crossed by any of the corridor segments retained for subsequent analysis.

In all three analysis steps, the comparison of corridors was based primarily on potential range productivity and recovery rates. The recoverability factor was given slightly more emphasis than productivity because

Table VII-8 - VEGETATIVE COMMUNITIES CROSSED

CORRIDOR SEGMENT	LENGTH (in miles)	LARCH-DOUGLAS FIR	LODGEPOLE PINE-DOUGLAS FIR	WESTERN MONTANA PONDEROSA PINE	INTERMOUNTAIN VALLEY GRASSLAND & MEADOW	FOOTHILL SAGEBRUSH	FOOTHILL GRASSLAND	NORTHERN GRASSLAND	TETON RIVER-JUDITH BASIN GRASSLAND	CENTRAL GRASSLAND	EASTERN MONTANA PONDEROSA PINE	RIPARIAN	BEARTOOTH JUNIPER-LIMBER PINE	PONDEROSA PINE SAVANNAH	SANDY GRASSLANDS	RANGELAND IMPACT RATING (Miles)			
																High	Moderate	Low	Total
A	111.4	-	-	-	-	-	-	-	-	56.0	18.5	-	33.1	3.8	-	18.5	33.1	59.8	200
B	241.8	-	11.4	36.7	4.6	-	58.9	21.5	70.8	33.0	-	-	-	3.9	1.0	36.7	71.8	133.3	424
C_1	134.2	-	7.9	-	3.5	5.6	54.5	-	16.4	34.7	-	1.8	-	2.8	7.0	-	30.8	103.4	165
C_2	7.0	-	-	-	-	-	-	-	2.6	-	-	4.4	-	-	-	-	7.0	-	14
C_3	13.2	-	-	-	-	-	7.4	-	5.8	-	-	-	-	-	-	-	5.8	7.4	19
C_4	20.1	-	-	-	-	-	20.0	-	0.1	-	-	-	-	-	-	-	0.1	20.0	20
D_1	130.7	-	5.5	-	-	-	76.7	-	0.6	21.8	19.3	-	-	1.8	5.0	19.3	5.6	105.8	194
D_2	35.7	-	-	-	-	5.0	-	6.5	21.5	-	-	2.7	-	-	-	-	29.2	6.5	65
D_3	39.2	-	18.9	-	15.3	-	-	5.0	-	-	-	-	-	-	-	-	-	39.2	39
D_4	10.7	-	2.6	-	8.1	-	-	-	-	-	-	-	-	-	-	-	-	10.7	11
E_1	8.3	-	-	-	-	-	8.3	-	-	-	-	-	-	-	-	-	-	8.3	8
E_2	11.2	-	9.2	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	11.2	11
E_3	32.5	-	8.7	5.8	18.0	-	-	-	-	-	-	-	-	-	-	5.8	-	26.7	50
F	42.7	-	23.9	-	14.1	-	4.7	-	-	-	-	-	-	-	-	-	-	42.7	43
G	78.3	8.3	9.5	14.5	46.0	-	-	-	-	-	-	-	-	-	-	14.5	-	63.8	122
H	48.5	21.9	-	22.6	4.0	-	-	-	-	-	-	-	-	-	-	22.6	-	25.9	116
I	61.2	-	12.4	10.6	38.2	-	-	-	-	-	-	-	-	-	-	10.6	-	50.6	93
J	4.7	-	-	-	4.7	-	-	-	-	-	-	-	-	-	-	-	-	4.7	5
K	35.7	-	-	-	35.7	-	-	-	-	-	-	-	-	-	-	-	-	35.7	36
L	16.1	-	-	-	16.1	-	-	-	-	-	-	-	-	-	-	-	-	16.1	16
M_1	36.6	10.5	-	18.2	7.9	-	-	-	-	-	-	-	-	-	-	18.2	-	18.4	92
M_2	9.3	-	-	9.3	-	-	-	-	-	-	-	-	-	-	-	9.3	-	-	37
M_3	11.3	-	-	11.3	-	-	-	-	-	-	-	-	-	-	-	11.3	-	-	45
N	32.2	-	-	-	-	-	32.2	-	-	-	-	-	-	-	-	-	-	32.2	32
O	30.0	-	14.9	-	0.6	3.0	-	0.8	10.7	-	-	-	-	-	-	-	13.7	16.3	44
P	23.6	-	2.5	10.9	10.2	-	-	-	-	-	-	-	-	-	-	10.9	-	12.7	56
Q	90.7	-	8.8	8.3	41.9	12.0	-	-	25.0	-	-	3.0	-	-	-	-	40.0	72.6	153
R	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.3	-	-	33
S	6.0	-	-	-	-	-	-	-	2.5	-	-	3.5	-	-	-	-	6.0	-	12

recoverability potential of a vegetative community essentially determines how significant any disturbance will be. The rangeland determinant impact ratings are the products of the numerical impact rating for each vegetative community and the number of segment miles crossing each community (see Figures III-8 and VII-4). Segment impact scores that comprise each corridor were then summed for each corridor (Table VII-9).

The Helena (MacDonald Pass) and Townsend-Boulder alternatives were rated slightly better than the Applicant's proposed corridor, which in turn was rated slightly better than the Helena (Avon Valley) alternative. Impacts on the rangeland resource would be significantly greater along the Siegel Pass and Great Falls alternatives than the other five corridors (see Figure VII-4 and Table VII-9).

Table VII-9 RANGELAND IMPACT SUMMARY

		IMPACT	SCORE		
CORRIDORS	LENGTH (in miles)	LOW	MEDIUM	HIGH	TOTAL
APPLICANT'S PROPOSED	431.3	38.8	75.8	316.7	623
SIEGEL PASS	446.3	84.7	75.8	285.8	776
GREAT FALLS	447.6	69.7	104.9	273.0	762
HELENA (MACDONALD PASS)	445.3	29.1	75.8	340.4	609
HELENA (AVON VALLEY)	445.7	40.0	75.8	329.9	641
TOWNSEND-BOULDER	443.2	29.1	77.6	336.5	609
TRIDENT-BOULDER	445.4	48.4	67.9	329.1	659
BUTTE-ANACONDA	461.2	48.4	78.7	356.0	708

Forest Land

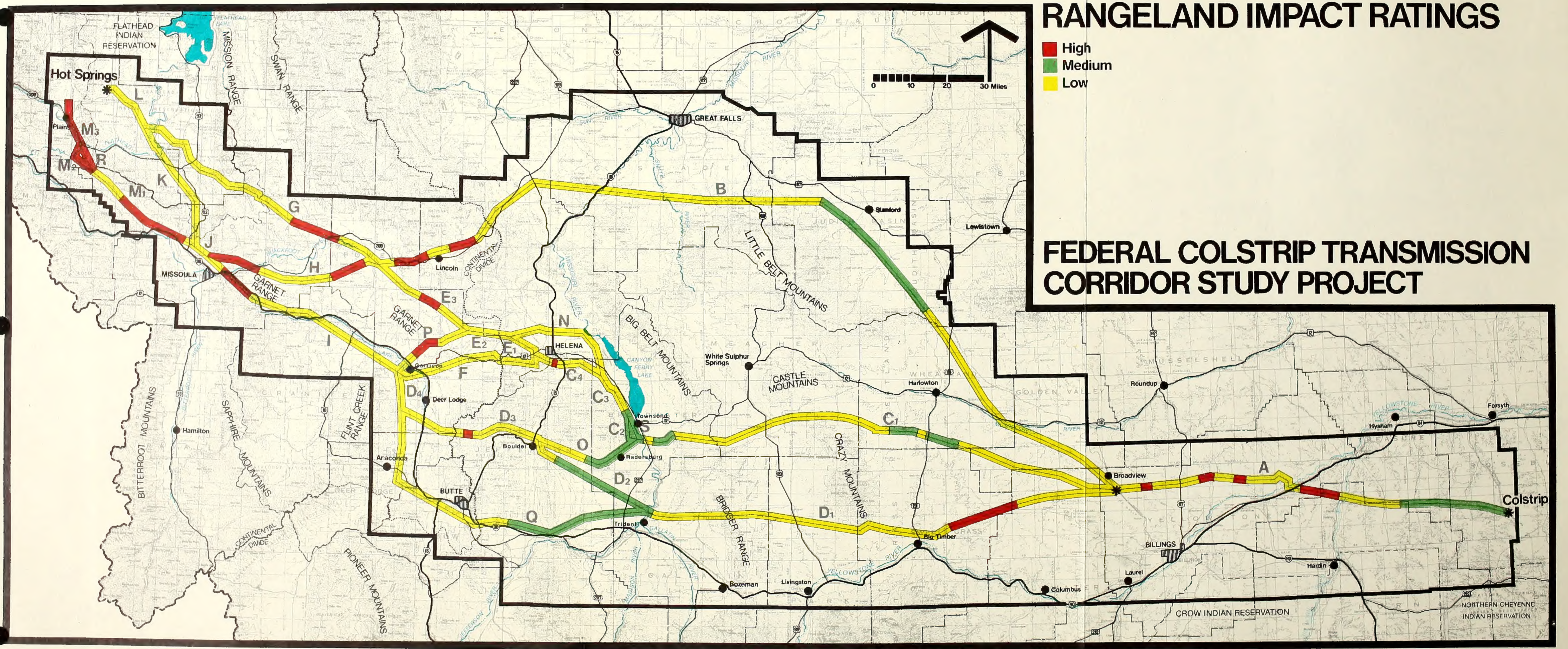
The least impact corridor in terms of the commercial forest land determinant is the Helena (MacDonald Pass) alternative (Table VII-10). The greatest impact along this corridor would be in the vicinity of Evaro

Hill west of Missoula, and along the Clark Fork Valley east of Missoula (Figure VII-5). Impact in these areas could be reduced by using existing powerline rights-of-way and access roads are utilized.

The next least impact corridor for commercial forests is the Butte-Anaconda alternative. In addition to the impact areas noted above, this corridor would traverse timbered lands in the vicinity of Flathead Pass, north of Bozeman, for a short distance. Since the impact difference between this corridor and the Helena (MacDonald Pass) alternative is rated only one percent, both are considered to have essentially the same potential impact.

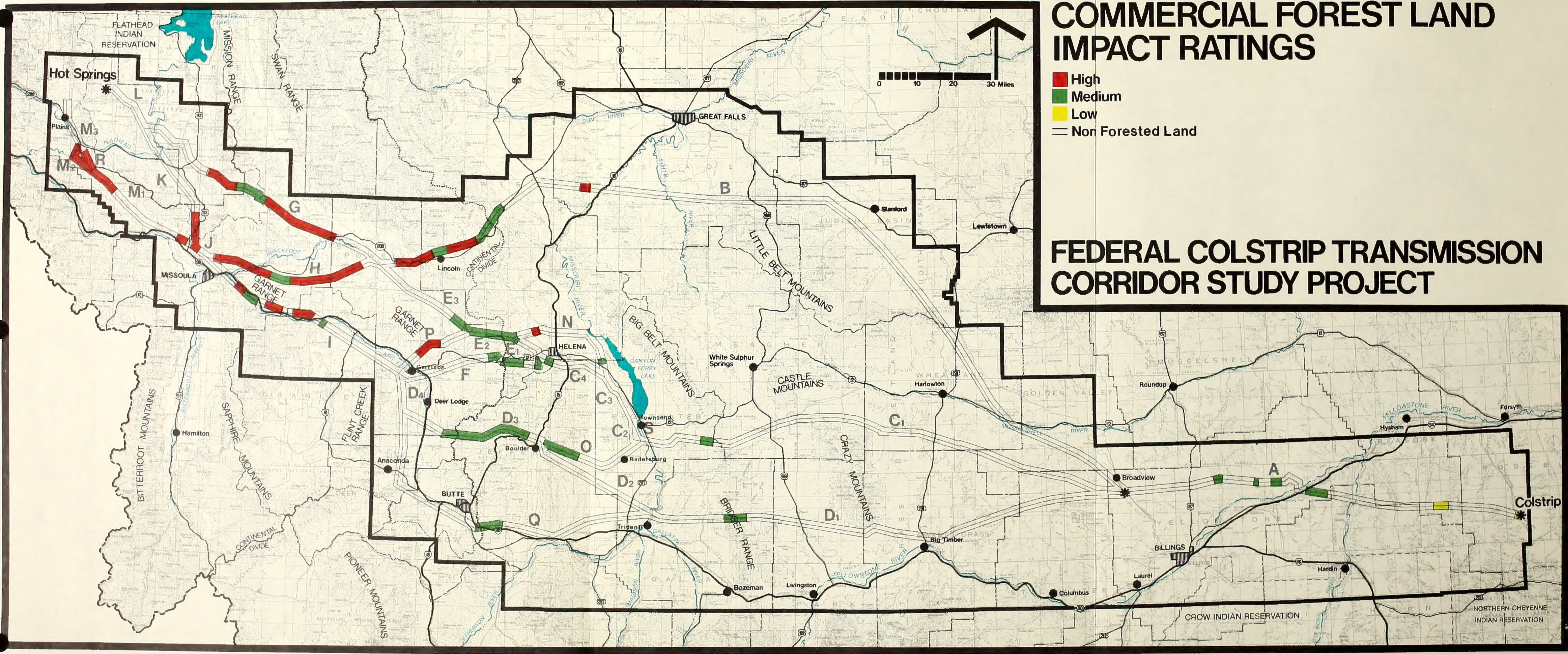
Table VII-10 COMMERCIAL FOREST LAND IMPACT SUMMARY

CORRIDORS	LENGTH (in miles)	COMMERCIAL FOREST LAND (miles)	POWERLINE RIGHT-OF-WAY ON COMMERCIAL FOREST LAND (acres)	POWERLINE RIGHT-OF-WAY (thousand cu. ft.)	ACCESS ROADS OUTSIDE POWERLINE R.O.W., ON COMMERCIAL FOREST LAND (acres)	ACCESS ROADS OUTSIDE POWERLINE R.O.W., (thousand cu. ft.)	TOTAL CLEARING OF COMMERCIAL FOREST LAND (acres)	TOTAL POWERLINE & ACCESS ROAD R.O.W., (thousand cu. ft.)	IMPACT SCORE FOR COMMERCIAL FOREST LAND
APPLICANT'S PROPOSED	431.3	91.8	3342	6567	577	1204	3919	7771	774
SIEGEL PASS	446.3	106.1	3862	7815	676	1443	4538	9258	969
GREAT FALLS	447.6	94.7	3448	6771	597	1242	4045	8013	876
HELENA (MACDONALD PASS)	445.3	49.8	1812	3209	285	560	2097	3769	369
HELENA (AVON VALLEY)	445.7	63.3	2305	4198	379	750	2684	4948	494
TOWNSEND-BOULDER	443.2	73.5	2675	5119	451	925	3126	6044	513
TRIDENT-BOULDER	445.4	66.6	2424	4756	402	857	2826	5613	471
BUTTE-ANACONDA	461.2	50.0	1819	3461	287	611	2106	4072	372



RANGELAND IMPACT RATINGS
🟥 High
🟩 Medium
🟨 Low
0
10
20
30 Miles
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
FLATHEAD INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
Hot Springs
Plains
M3
M2
R
M1
K
L
G
J
H
MISSOULA
GARNET RANGE
Lincoln
CONTINENTAL DIVIDE
E3
GARNET RANGE
P
E2
E1
N
HELENA
Garrison
F
C4
D4
Deer Lodge
C3
D3
I
BITTERROOT MOUNTAINS
Hamilton
SAPPHIRE MOUNTAINS
FLINT CREEK RANGE
Anaconda
Boulder
O
C2
S
Townsend
Radersburg
CANYON FERRY LAKE
BIG BELT MOUNTAINS
D2
BUTTE
Q
Trident
CONTINENTAL DIVIDE
PIONEER MOUNTAINS
BRIDGER RANGE
Bozeman
Livingston
GREAT FALLS
B
Stanford
LITTLE BELT MOUNTAINS
Lewistown
White Sulphur Springs
CASTLE MOUNTAINS
C1
CRAZY MOUNTAINS
D1
Big Timber
Harlowton
Roundup
Hysham
Forsyth
Broadview
A
Colstrip
BILLINGS
Laurel
Columbus
Hardin
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
MISSOURI RIVER
SUN RIVER
YELLOWSTONE RIVER
MUSSELSHELL RIVER
GALLATIN RIVER

Figure VII-4



COMMERCIAL FOREST LAND IMPACT RATINGS

🟥 High
🟩 Medium
🟨 Low
═ Non Forested Land

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure VII-5

The Trident-Boulder alternative is the third least impact corridor for commercial forests. Areas of high impact include Evaro Hill, Clark Fork Valley, and the timbered lands north of the Boulder River. The impact along this corridor is rated approximately 28 percent greater than along the Helena (MacDonald Pass) alternative.

The Helena (Avon) and Townsend-Boulder alternatives are rated nearly the same for forestry impact, as there is only a five percent difference between the two. The Helena (Avon) corridor has a 34 percent higher impact rating than the Helena (MacDonald Pass) alternative because it encounters more timbered land west of Helena. The Townsend-Boulder alternative crosses timbered land west of Townsend and north of the Boulder River in addition to the Evaro Hill and Clark Fork Valley areas. This gives the corridor a 39 percent higher impact rating than that of the Helena (MacDonald Pass) alternative.

The impact rating for the Applicant's proposed corridor is 109 percent higher than that for the Helena (MacDonald Pass) Alternative because of the extensive forest lands crossed, both west of Helena and in the Placid Lake-Upper Jocko River area.

The Great Falls alternative ranks seventh for impact. The greatest impact would occur in the area from Rogers Pass west through the Placid Lake-Upper Jocko River area. The impact rating for this corridor is approximately 137 percent higher than that for the Helena (MacDonald Pass) alternative.

The Siegel Pass alternative has the highest impact score of all the corridors. The highest impacts are in the Blackfoot River country and in the Ninemile Creek-Siegel Pass area. Impacts along this corridor would be approximately 163 percent greater than along the Helena (MacDonald Pass) alternative.

FISH AND WILDLIFE

DISCUSSION

Fish

Few impacts on fisheries are expected from the construction, presence or maintenance of an extra high voltage transmission line between Colstrip and Hot Springs. None are expected from its operation.

Erosion and sedimentation are natural phenomena, and even the clear and cold water trout species are adapted to periodically heavy sediment loads, such as generally carried by high spring runoffs. Sediments introduced during low water periods might be deposited on the stream bottoms until scoured out by the next high runoff. This could result in the silting-in of spawning gravels, and the loss, through suffocation, of a year's fish production.

Construction of roads and preparation of tower sites would inevitably bring increased erosion and sedimentation. Sedimentation from construction-triggered land failures (a specific or "point" pollution source) may introduce sufficient sediment loads to streams to silt-in fish spawning gravels until the stream bottom is scoured out by high runoff. The amount of additional sedimentation from "non-point" sources would probably be well within the load carrying capacity of the streams involved, and would taper off as roadcuts and tower sites revegetate. It would be, however, an additional contribution toward the threshold of a stream's load-carrying capacity and possible long-term stream degradation. Sedimentation risks associated with land suitability units are discussed in the "Surface Water" section of this chapter.

Increases in stream temperatures which are dependent on stream volume, velocity, and surface areas exposed usually accompany the removal of streamside vegetation. Crossing streams at near-perpendicular angles would limit the loss of forest canopy to 300 feet or less. The temperature increases along a 300-foot opening would be expected to be generally insignificant. However, by displacement of the centerline, right-of-way clearing could be located away from the vicinity of any stream channel paralleled by a corridor.

The Applicant has stated that herbicides would not be used (WESD/AEA 1973) in construction or maintenance of this line. Thus no discussion of potential herbicide pollution or its effect on fish and wildlife is warranted, except for the BPA-Build Alternative, as discussed later in this chapter.

The productivity and recreational values of Montana trout streams have both been rated by the Montana Department of Fish and Game. The number of rated trout streams crossed by each alternative is shown in Table VI-3, column 13. These figures suggest that little difference in the number of trout streams impacted by crossing is to be found between the Applicant's proposed and any alternative corridor.

Non-Forested Wildlife Communities

Construction Impacts

The construction of an extra high-voltage transmission line from Colstrip to Hot Springs would have only slight impact on non-forested wildlife communities. The pattern, distribution and structure of existing sagebrush, grassland and agricultural vegetative types would remain essentially unaltered.

Approximately six acres per mile of line would be disturbed in the construction of roads and towers. Recovery of vegetation is estimated at three to eight years, with a little more than two acres per mile permanently lost to road surface (see the "Vegetation" section of this chapter for a more complete discussion).

Towers on agricultural land would preclude farming the area at the base of each tower. These areas could provide cover for birds (including pheasants) and small mammals, but would probably be too small and too far apart to be of great value.

Clean farming and field consolidation have reduced wildlife cover in Montana. Displacement of roads and towers into agricultural "wastelands" could further reduce this cover.

Most wildlife species do not exhibit a tendency to avoid transmission line structures. Waterfowl and gulls have shown inconsistent avoidance (Hunt 1972; Gunter 1956; Fog 1970) of lines. No avoidance of transmission lines by waterfowl has been noted in Montana, though transmission lines pass near numerous wetlands and waterfowl areas (Thompson 1977). A study in Oregon has shown no differential selection by antelope or deer of brushland desert habitats under or near a 400-kV dc line (Griffith 1977).

Birds, especially waterfowl, will occasionally be killed flying into a transmission line or structure. These deaths generally represent an insignificant fraction of non-hunting mortality (Stout and Cornwell 1976; Lee 1978).

The presence of transmission line structures may allow limited pioneering of new habitat by eagles and other large raptors previously excluded by lack of perches or nest support. This could become an additional predation factor in the population dynamics of many small prairie animals, though with negligible effect. The presence of a raptor perch near grouse drumming or dancing grounds could disrupt display activities. Interspecific competition from the new raptors could adversely affect existing raptor population, though the limited pioneering opportunity similarly limits potential competition.

The utilization of the transmission line structures by raptors for perching or nesting may indirectly result in additional mortality to raptors, as raptors perched on towers make easy and tempting targets for unethical shooters (Boeker 1972).

Construction noise and activity would temporarily displace a variety of wildlife except where that activity destroys the home range of species such as field mice or shrews. Because of the extremely small home ranges of such species, viable breeding populations can be maintained on relatively small areas; consequently, population losses would probably be limited to those animals occupying the right-of-way. Some animals may survive by leaving the construction area but intra-specific competition in temporarily more crowded areas would probably eliminate them as effective breeders. The same territorial interactions, coupled with the high reproductive rates of the small mammals, would promote rapid pioneering of disturbed areas following vegetative recovery. Introduction of new vegetation may favor small mammals other than those originally displaced.

The displacement of wildlife would depend partially on the conditioning of those species to human activity. Much of the wildlife in sagebrush and grassland vegetation types is already conditioned to the sight and sound of rancher's pickups and heavy agricultural equipment. Construction activity near sage grouse strutting grounds or sharp-tailed grouse dancing grounds could disrupt display activity, though displaying birds often seem oblivious to vehicular approach.

Harassment of wildlife by construction crews is a possible impact under control of the contractor. Ingestion by wildlife of construction hardware is another possible impact easily prevented by the contractor.

Long-term vehicular access and associated pressures on wildlife would probably increase only slightly in non-forested habitats, since off-road vehicle trails already traverse much of the sagebrush and grassland types. Access roads on agricultural lands would probably be obliterated.

Operation and Maintenance Impacts

The activity of maintenance crews would cause brief disruption of wildlife habits. Low level helicopter line patrols may cause brief flight reactions in wildlife. Fixed wing aircraft would cause less of a reaction.

Electrical effects of the transmission line on wildlife would be negligible. Electrocution of birds is highly unlikely because the distances between conductor phases exceed the wingspan of even the largest birds. Nuisance shocks, caused by induction between wildlife and ungrounded objects, are a remote possibility. There is no evidence that 500-kV coronas produce oxidants (such as ozone) in quantities harmful to wildlife living or passing beneath the lines (Lee and Griffith 1977; Lee 1977).

Forested Wildlife Communities

Construction Impacts

Edge and Interspersion - Among the most important impacts on a forested wildlife community from the construction of an extra high-voltage transmission line is the necessary clearing of a 300-foot wide right-of-way. Very limited regrowth of trees to the sapling size class (up to 5 inches diameter breast high) may be permitted under transmission lines, but a roughly linear 300-foot wide, early-seral vegetative community should be assumed to be the long-term impact.

This linear seral community is often cited as a beneficial effect of powerlines, creating edge and increasing the diversity of habitat (BPA 1977). However, the effective increase in habitat diversity and the value of the edges created in a Northern Rocky Mountain coniferous forest are questionable. Rights-of-way are linear communities having rather abrupt and uniform edges. Species richness is more dependent on a complex mosaic of size and type and an irregular inter-digitating edge (Thomas, et al. 1977). Whereas edges themselves are usually assumed to support greater species diversity than the flanking communities (ibid.), little evidence of this is indicated for birds of the intermountain West (Balda 1975), or from preliminary investigations of the coniferous forests of western Montana (Thompson 1977). Ramirez, studying small mammals of forested and cutover areas in northwestern Montana (1977), found greater species diversity in forested habitat than in cutover areas, though clearcuts did add to overall diversity by providing habitat for species not present in forested areas (e.g., ground squirrels and deer mice). Edge effect was not noted.

Fragmentation of Habitats - The numbers of species supported by a given habitat are usually positively correlated to the size of the habitat (Galli, et al. 1976). Fragmentation of habitat can reduce species diversity. Though the effectiveness of a power line right-of-way or access road in separating stands of habitat is probably minimal (Thompson 1977), rights-of-way do represent increments of fragmentation and may provide opportunity for further fragmentation of habitats.

The mature subalpine forest communities support wildlife which is susceptible to habitat fragmentation. The proposed transmission line right-of-way approaches the limit of the width of an opening a pine marten will cross (Koehler 1975). Limits of opening size acceptability have not been described for fishers or three-toed woodpeckers. Wolverine generally avoid clearcut areas, except for limited activities around the edge, or direct crossing (Hash 1977).

Species Diversity - Slight increases in wildlife species diversity would probably result from a transmission line right-of-way in a forested Montana habitat. However, simple increase in species diversity may not represent an increase in the value of wildlife habitat. As Balda (1975:77) points out:

> Many species of birds attracted to edges have rather broad ranges of tolerance, good powers of dispersal and high reproductive rates (one could refer to some of them as "weed species"), and are in no immediate danger because of habitat destruction and deterioration. It is species with very narrow ranges of tolerance and possibly minimal powers of dispersal that need our attention, and seldom are these edge species.

Forage and Cover - The removal of forest canopy by transmission line right-of-way clearing would increase forage production on most sites through removal of the moisture and light competition of the forest canopy. The amount of increase would depend on existing understory composition, residual seeds in forest duff, vegetative habitat types, and methods of slash disposal.

The value of increased forage production to large herbivores depends on its availability and relative abundance. Obviously, the energy derived by wildlife from the consumption of forage must exceed the energy expended to access and consume the forage if that forage is to be of any value. Energy used in accessing forage depends on the proximity of cover and the actual and perceived security of the animal foraging there. The relative proximity of forage and cover necessary to optimize the ratios of energy conservation, consumption and expenditure will vary with local snowfall accumulations, temperatures, wind, and season of use.

The significance of the forage and cover relationships created by the clearing of a transmission line right-of-way would be strongly influenced by the pre-existing patterns of forage and cover. Present patterns of timber harvest have already increased forage production and reduced the available cover on many of the wildlife ranges involved. Further increases in forage production may be unnecessary, and reductions in cover undesirable.

Construction Activities - Construction noise and activity temporarily displace wildlife. Elk, in particular, would probably move so that some protective topographic feature is between them and the activity. Harassment of wildlife by construction crews would be a possible impact, but much of this harassment could be prevented by the contractor.

Unintentional and damaging confrontations with grizzly bears would also be possible, and not entirely preventable by the contractor. Disturbance of denning bears, both grizzly and black, could place increased physiological demands on the bears at a time when food is not available, and newborn young might not be capable of withstanding exposure. The probability of disturbing dens would be relatively low because of their highly scattered distributions and the seasonal limitations on construction.

The construction of the proposed transmission lines would require 1.6 miles or more of roads per mile of line within forested types. These types are generally located in steeper, rougher country than the sagebrush and grassland types. Because of this additional length and the necessity of cutting steep slopes to build roads, six to twelve acres of vegetative cover could be temporarily disturbed per mile of line. Revegetation of tower sites and road cuts would reduce this to a long-term loss of a little over three acres per mile, though new vegetation would generally represent forage rather than shelter or security.

The increased access provided by the roads and the reduced cover along rights-of-way can result in increased hunter pressure and more rapid harvest of game. Hunting seasons might have to be shortened to compensate for this. Restricted hunting seasons reduce recreational opportunity and can mean a loss of recreation dollars to the local economy.

Access could be controlled by road closures, though such closures are not always accepted or obeyed by the public. Failure to effectively control access could result in increased public harassment of wildlife, both intentional and unintentional.

Operation and Maintenance Impacts

The impacts of operation and maintenance are the same as for non-forested wildlife communities, except that eagles and other large raptors would not find towers as significant for perches or for nesting in forested habitats.

Summary

Complex interrelationships exist between the interspersion of forage and cover and the seasonal distributions and habitat utilization of wildlife. The necessary considerations of angles and alignment make it impractical to design a transmission line to enhance wildlife habitats. Beneficial impacts of forage production and edge would accrue in certain situations, and many species of wildlife can tolerate, if not adapt to, such changes in their environment.

However, considering:

1. the questionable contributions of a transmission line right-of-way to increased diversity of wildlife;

2. the relatively common species most probably favored by a seral right-of-way community and edge;

3. the possible compromise, through habitat fragmentation, of wildlife species of special interest or concern;

4. the undemonstrated need for increased forage production;

5. the difficulty in developing forage and cover relationships by right-of-way placement and management which would optimize forage availability where it might be needed;

6. the unavoidable compromise of major cover areas which may be interspersed with areas where a right-of-way could beneficially increase forage; and

7. the problems of wildlife harassment, displacement or destruction as a result of increased access, the probable net impact of a transmission line through forested Montana wildlife habitats would be slightly to moderately detrimental (see Figure VII-6).

Species-Related Wildlife Impacts

Game

Black bear may benefit from increased forb and berry production along the right-of-way edge. Bears using the right-of-way may be exposed to increased spring hunting pressure. Disturbance of denning bears by construction may stress the individuals involved, especially young of the year.

Deer, elk and moose may suffer from loss of cover on key winter ranges. Key winter ranges are occupied during periods when snow cover and exposure place high energy demands on animals moving into an opening to forage. Increased forage production on a right-of-way could be inaccessible because of increased snow depths on the right-of-way, especially in

FISH AND WILDLIFE IMPACT RATINGS

🟥 High
🟩 Moderate
🟨 Low

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

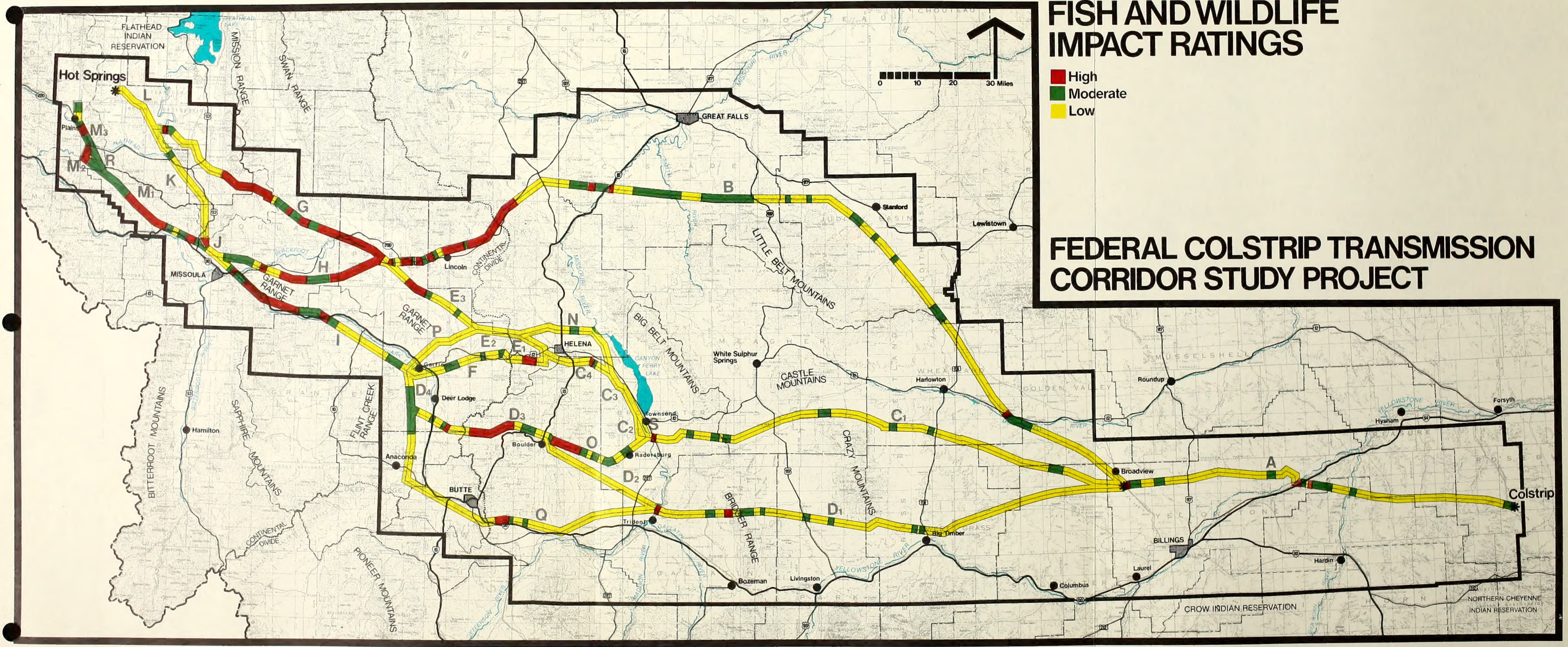


Figure VII-6

western Montana. Winds may scour openings free of snow on ranges east of the Continental Divide, but cover is less available there, and wind chill can be more demanding. Selective removal of large trees along a right-of-way may be nearly as damaging as clearcutting to elk on key winter ranges, because large trees are preferred bedding sites (Allen, et al. 1976).

General winter ranges include areas where forage produced in a right-of-way can be valuable as a food source in late winter and early spring. These areas are often interspersed with important components of cover. The value of forage produced may or may not compensate for the diminished values of cover.

The remaining general distributions mapped include summer and fall ranges. Deer and elk tend to avoid openings during this period, especially white-tailed deer and elk in western Montana. Forage produced on a right-of-way would, therefore, be superfluous. The areas disturbed would probably not be a large enough percentage of available summer range to adversely affect populations. Fall staging and security areas are not well identified, but a right-of-way could significantly reduce the values of such areas.

Moose may make somewhat greater utilization of right-of-way openings for foraging than deer or elk, though again, need for forage has not been established.

Threatened and Endangered Species

Grizzly Bear

Grizzly bears might reap slight benefit from increased herb and berry production along a transmission line right-of-way. Need has not been established.

The right-of-way could be used by grizzly bears as a travel lane (Jonkel 1977), providing opportunities for a grizzly bear to move into new habitat, including habitat where the chance of human confrontation is much greater (Erickson 1976).

If right-of-way access is not effectively closed, then human-grizzly confrontation may totally negate any beneficial impacts (Jonkel 1977). Grizzly bear reproductive potentials are quite low and they may not be able to compensate for increased mortality resulting from human-grizzly confrontations. Disturbance and accidental confrontation of bears by construction crews is a possible impact.

The Applicant's proposed corridor over Jocko Pass and the Great Falls alternative over Rogers Pass lie within the boundary of proposed grizzly bear critical habitat. Neither corridor affects any identified grizzly bear concentration areas, though data is limited (Jonkel 1977). Corridor elevations are generally below the 5,800 foot contour; most important grizzly bear habitat components occur above that elevation (Mealey, et al. 1977). However, the Applicant's proposal west of Jocko Pass is aligned near the ridgeline thus possibly involving habitat types which may be important grizzly foraging areas. The Jocko-Mission-Placid divide area may be an important grizzly bear movement corridor between the Mission Mountains and the McCleod Peak country (Servheen 1977).

Bald Eagle

No bald eagle sites have been identified in the study area. Sufficient latitude would probably be available during centerline location to avoid any nest sites found. It is unlikely that powerline structures themselves would impact nesting bald eagles unless the right-of-way would expose a nest site to public harrassment.

Black-footed Ferret

The black-footed ferret has not been seen in Montana for many years. Little or no impact is expected on the ferrets' exclusive prey, the prairie dogs. No subsequent impacts on black-footed ferrets are anticipated.

Rocky Mountain Timber Wolf

Rocky Mountain Timber Wolf denning sites have not been identified in Montana. The most frequent recent sitings have been outside the study area. No impacts to wolf populations are expected.

Whooping Crane

Whooping crane cross numerous transmission lines and man-made structures along present migration routes without apparent incidents. Collision with towers or structures are the only possible impacts to this migrant.

Falcons

Prairie and peregrine falcons eyries have not been located along the Applicant's proposal or alternative corridors. Should segment M_3 be selected as part of an overall corridor, additional studies would need to be conducted to determine the extent and specific locations of peregrine falcon nesting sites (Haynam and Summer 1977). The centerline should be located to provide adequate isolation for each nesting site.

CORRIDOR COMPARISONS

Comparison of corridors reveals which corridor crosses the least amount of significant wildlife habitat (see Figure VII-6). Selecting the corridor which would avoid as much significant wildlife habitat as possible would represent mitigation of impacts at the broadest scale. The wildlife impact rating system developed in Step 1 of the corridor analysis process was applied in the Step 2 and Step 3 comparisons of corridors. The ratings and total wildlife impact scores are presented in Tables VII-11 and 12.

Differences in impact scores, in wildlife distributions and features of habitat not apparent in these scores and unmitigable impacts are discussed under Unavoidable Impacts (Chapter IX).

Table VII-11 - FISH AND WILDLIFE IMPACTS

CORRIDOR SEGMENT	LENGTH (in miles)	IMPACT POTENTIAL (miles)			SUM OF DATA ITEM SCORES	DETERMINANT SCORE
		LOW	MODERATE	HIGH		
A	111.4	90.4	16.0	5.0	142	284
B	241.8	139.0	62.0	41.0	401	854
C_1	134.2	119.0	14.0	1.2	152	304
C_2	7.0	7.0	7.0	-	7	14
C_3	13.2	13.2	-	-	13	26
C_4	20.1	18.1	1.0	1.0	24	48
D_1	130.7	116.7	11.0	3.0	151	302
D_2	35.7	35.7	-	-	36	72
D_3	39.2	18.2	8.0	13.0	86	172
D_4	10.7	4.0	6.7	-	18	36
E_1	8.3	7.7	0.6	-	9	18
E_2	11.2	11.2	-	-	11	22
E_3	32.5	22.5	4.0	6.0	54	108
F	42.7	30.0	9.7	3.0	62	124
G	78.3	26.3	17.0	35.0	201	402
H	48.5	9.0	17.0	22.5	135	270
I	61.2	25.0	15.0	21.2	139	278
J	4.7	4.0	-	0.7	8	16
K	35.7	32.0	2.0	1.7	44	88
L	16.1	16.1	-	-	16	32
M_1	36.6	2.0	17.6	17.0	106	212
M_2	9.3	-	5.0	4.0	26	52
M_3	11.3	4.0	3.0	4.0	26	52
N	32.2	30.2	-	2.0	38	76
O	30.0	10.0	11.0	9.0	68	136
P	23.6	23.6	-	-	24	48
Q	90.7	78.7	8.0	4.0	111	222
R	8.3	1.3	7.0	-	15	30
S	6.0	6.0	-	-	6	12

Table VII-12 FISH AND WILDLIFE IMPACT SCORES

CORRIDORS	LENGTH (in miles)	LOW IMPACT POTENTIAL	MODERATE IMPACT POTENTIAL	HIGH IMPACT POTENTIAL	1(L) + 2(M) + 4(H)	X2 DETERMINANT SCORE
APPLICANT'S PROPOSED	431.3	330.5	52.6	48.2	628	1256
SIEGEL PASS	446.3	308.4	80.2	57.5	701	1402
GREAT FALLS	447.6	271.8	95	81	786	1572
HELENA (MACDONALD PASS)	445.3	353.8	57.7	33.8	606	1212
HELENA (AVON VALLEY)	445.7	366.3	48.6	30.8	588	1176
TOWNSEND-BOULDER	443.2	318.7	72.7	51.8	673	1346
TRIDENT-BOULDER	445.4	342.1	58.7	44.6	640	1280
BUTTE-ANACONDA	461.2	366.9	58.7	35.6	629	1258

LAND USE

AGRICULTURE

Discussion

The potential impacts of a transmission line crossing agricultural lands relate primarily to acreages removed from production and increased difficulty of farming near tower bases or guying cables. Some impacts from construction activities are of short duration whereas others persist for the lifetime of a project. Each potential impact is discussed in relation to type, probability of occurrence, time frame, magnitude and relevance for each corridor.

All corridors cross both irrigated and non-irrigated agricultural land, so the same types of impacts would be expected to occur on each corridor (Figure VII-7). Also, the time frame and probability of occurrence for each impact would be the same regardless of location. The magnitude and relevance of each impact are factors which provide data for evaluating differences among the alternatives. These factors relate directly to the extent of agricultural land in each class crossed.

The following analysis of impacts is organized: first, to identify types of potential impacts; second, to provide general information for all corridors concerning both the probability of an impact occurring and its potential duration; and third, to analyze differences among corridors based on magnitude and relevance of each impact.

Types of Impacts Identified

When a transmission line is built across agricultural farmland, the following impacts may occur, depending on centerline location, tower design and siting, and construction and maintenance techniques used:

1. land occupied by tower bases and guy wires is removed from production;

AGRICULTURAL LAND IMPACT RATINGS

🟥 High
🟩 Medium
No Agricultural Land

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

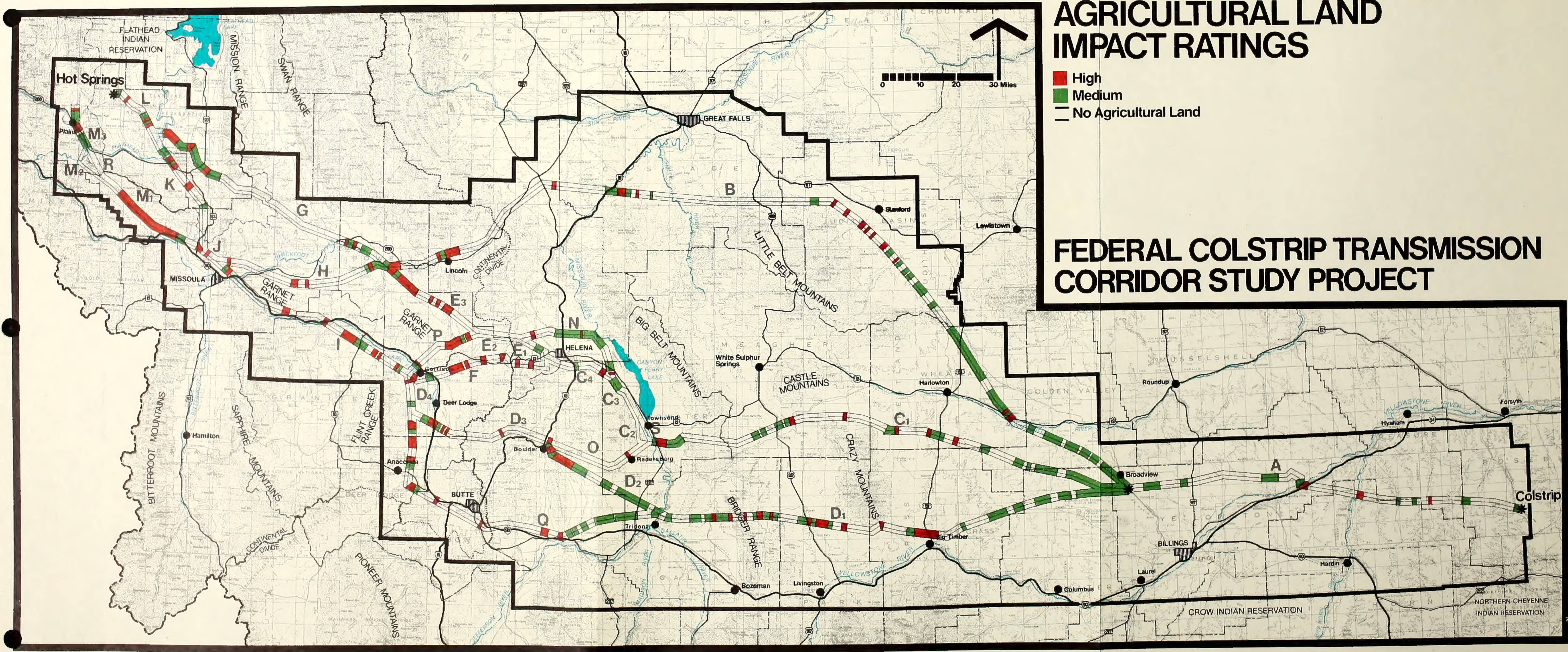


Figure VII-7

2. land used for access roads and construction activities is removed from production;

3. future productivity may be reduced due to soil compaction, disturbance or erosion resulting from construction activities;

4. operation of automated irrigation systems may be hampered;

5. movement of equipment for tilling, seeding, spraying, and harvesting may be impaired; and

6. nuisance impacts from cropland damage outside of construction boundaries, fence or gate damage, gates left open, and improper debris clean-up may result.

Impact Probability and Time Frame

All alternative corridors cross both irrigated and non-irrigated land. In some areas, the fields are small and interspersed with range or wasteland, and towers could probably be sited to span the farmlands. Nevertheless, there are areas of concentrated irrigation or dryland farming where it would be necessary to place towers in fields. Thus, the removal of at least some land from agricultural production would be certain for any corridor selected. Because this land would be occupied by towers and guying cables, the impact would last the lifetime of the project.

Land must be used for access roads and construction activities. Land in all corridors would definitely be impacted by these activities. In most cases, the major impact would be of short duration, lasting only the time required for all construction activities. Following construction, most of the land can be returned to production. Certain permanent access roads may need to be retained, but existing county roads would serve access requirements for most maintenance activities. Occasionally it may be necessary to cross a cropped field for maintenance purposes.

Although most land used for construction purposes would be returned to agricultural production following the construction phase, production would likely be reduced temporarily as compared to undisturbed areas. Numerous studies have shown that soil compaction reduces root growth and plant yield (Barton, et al. 1966; Barley and Greacen 1967; Moe, et al. 1971; Troughton 1962; Zimmerman and Kardos 1961). Ferguson (1977) states that increasing soil bulk densities through compaction decreases root penetration. When the bulk density approaches 1.7-1.8 g/cc, roots cannot penetrate the soil at all, except along cracks between soil peds. Normally, soil bulk densities range from 1.2 to 1.6 g/cc for soils in good physical condition for plant growth (Russell, 1973). Other soil disturbances, especially if they result in erosion, would be expected to reduce production.

These influences on reduced production would probably last for two to three years beyond the construction period. The duration would depend on specific soil characteristics (Moe, et al. 1971), but as the soil is tilled and plant growth increases, most soils would return to normal within a few years (Russell 1973).

Powerlines crossing irrigated land could necessitate changes in irrigation practices, or limit future development, as a result of tower locations. Wheel type irrigation systems, including center pivot units, cannot pass through fields where there are tower or guy lines. Special considerations are required for installing, operating, and maintaining all mechanized systems in proximity to powerlines (Wacker 1977). All alternative corridors cross areas of concentrated irrigation, so this type of impact would occur regardless of the alternative selected, and would endure for the lifetime of the project.

A serious impact would occur on large expanses of nonirrigated farmland. Successful dryland farming depends on efficient use of large equipment, and it is generally not possible to farm beneath guy lines. It is also difficult to farm around such obstructions with large equipment, particularly where strip or contour farming practices have been established. Again, because all corridors cross concentrated areas of dryland farming, this impact would occur for the lifetime of the project.

A general category of impacts, referred to here as "nuisance impacts," is reported to occur in association with line construction and maintenance on agricultural land (DNRC/DEIS 1974:214). These nuisances, which generally result in monetary losses, include damage to crops, fences and other facilities, straying of livestock due to gates being left open, and difficulties in farming or for grazing livestock involving leftover debris. This type of impact is avoidable, but would probably occur to some degree, regardless of which corridor is selected. Nuisance problems would occur both during the construction phase and for the life of the project.

Corridor Comparisons

Impact Magnitude and Relevance for Each Corridor

Potential impacts on agricultural lands were addressed (in Steps 2 and 3) by measuring the miles of each type of farm land crossed (dryland or irrigated) and applying the appropriate number analogs. Differences in agricultural impact scores between alternative corridors are shown in the results section of Chapters V and VI (Tables V-6 and VI-5), where each determinant impact score is presented. These values correlate the seriousness and importance of impacts on agricultural land with that for impacts on other resources within the study area. An assessment of the economic relevance and magnitude of impacts on agricultural land within each corridor--based on area potentially taken out of production--is discussed below.

According to Montana Power Company, 4.1 towers per line per mile would be required. It is proposed that guyed towers be used except at river crossings or other points where more strength is required. At these locations, self-supporting towers would be used. The State's final EIS states that "Though the construction plans call for approximately 80 percent guyed towers, no guyed towers are planned for agricultural land" (DNRC/FEIS, 1975:157). However, for the purpose of a "worst-case" analysis, it is assumed that guyed towers would be used on agricultural land, at a ratio of five per mile per line. The area within the guy lines would be 118 feet on a side, for a total of 13,924 square feet or

0.32 acres. The area beneath guy lines of ten towers would be 3.2 acres, which is the amount of land potentially removed from production as long as the towers would remain. For dryland agriculture where large equipment is used, this figure was utilized for calculations. If self-supporting towers are constructed, only 0.26 acres per mile would be removed from production, and the values in Table VII-13 for dryland acreages would be reduced by a factor of approximately 10.

On irrigated land, assuming that the area within guy lines could be watered and that farming equipment would be small enough to farm around the lines, there would be less land potentially taken out of production. An area about 15 feet square for each line and the tower base would be unusable, for a total area of 1,125 square feet per tower (15 ft. x 15 ft. = 225 sq. ft. x 5 = 1,125 sq. ft.). For ten towers (one mile of two lines) this would be 11,250 square feet or 0.26 acres per mile. Essentially all of the 300-foot right-of-way could conceivably be removed from irrigated production if irrigation system requirements are not considered during tower siting (e.g., the line angling across the center of an irrigated field watered by a wheel-type system). If such situations were allowed to occur, the entire 36.36 acres per mile of right-of-way could be removed from production. Also it is probable that portions of irrigated fields would be cut off from access to wheel or center pivot systems if lines cross fields, thus removing even more acres from irrigated production. Thus, using the figure of 0.26 acres of irrigated land removed from production may considerably understate the impact; higher projections are probably justified. Careful centerline location and tower siting could help eliminate these potential problems in certain areas.

The corridor impact comparison data in Table VII-13 reflect the above estimates (3.2 A/mile and 0.26 A/mile, respectively, for nonirrigated and irrigated land.

The impact, expressed as acres of irrigated and non-irrigated land taken out of production by tower bases and guying cables, is rated least for the Townsend-Boulder and Helena (MacDonald Pass) alternative corridors. These are followed in order by the Helena (Avon Valley), Siegel Pass,

Table VII-13 - FARMLAND CROSSED AND REMOVED FROM PRODUCTION

CORRIDOR SEGMENT	LENGTH (in miles)	APPLICANT'S PROPOSED				SIEGEL PASS				GREAT FALLS				HELENA (MacDonald Pass)				HELENA (Avon Valley)				TOWNSEND-BOULDER				TRIDENT-BOULDER				BUTTE-ANACONDA			
		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY		IRRIGATED		DRY	
		Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
A	111.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4	1	0.3	12	38.4
B	241.8	-	-	-	-	-	-	-	-	6	1.6	69	220.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C_1	134.2	5	1.3	42	134.4	5	1.3	42	134.4	-	-	-	-	5	1.3	42	134.4	5	1.3	42	134.4	5	1.3	42	134.4	-	-	-	-	-	-	-	-
C_2	7.0[1/]	1	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C_3	13.2	-	-	2	6.4	-	-	2	6.4	-	-	-	-	-	-	2	6.4	-	-	2	6.4	-	-	-	-	-	-	-	-	-	-	-	-
C_4	20.1	-	-	1	3.2	-	-	1	3.2	-	-	-	-	-	-	1	3.2	-	-	1	3.2	-	-	-	-	-	-	-	-	-	-	-	-
D_1	130.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2.1	47	150.4	8	2.1	47	150.4
D_2	35.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.8	16	51.2	-	-	-	-
D_3	39.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.5	3	9.6	2	0.5	3	9.6	-	-	-	-
D_4	10.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3	1	3.2	1	0.3	1	3.2	1	0.3	1	3.2
E_1	8.3	-	-	2	6.4	-	-	2	6.4	-	-	-	-	-	-	-	-	-	-	2	6.4	-	-	-	-	-	-	-	-	-	-	-	-
E_2	11.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E_3	32.5	8	2.1	3	9.6	8	2.1	3	9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	42.7	-	-	-	-	-	-	-	-	-	-	-	-	5	1.3	1	3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G	78.3	4	1.0	16	51.2	-	-	-	-	4	1.0	16	51.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	48.5[3/]	-	-	-	-	3	0.8	4	12.8	3	0.8	4	12.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I	61.2	-	-	-	-	-	-	-	-	-	-	-	-	3	0.8	6	19.2	3	0.8	6	19.2	3	0.8	6	19.2	3	0.8	6	19.2	3	0.8	6	19.2
J	4.7	-	-	-	-	1	0.3	-	-	-	-	-	-	1	0.3	-	-	1	0.3	-	-	1	0.3	-	-	1	0.3	-	-	1	0.3	-	-
K	35.7	-	-	-	-	-	-	-	-	-	-	-	-	4	1.0	7	22.4	4	1.0	7	22.4	4	1.0	7	22.4	4	1.0	7	22.4	4	1.0	7	22.4
L	16.1	2	0.5	5	16.0	-	-	-	-	2	0.5	5	16.0	2	0.5	5	16.0	2	0.5	5	16.0	2	0.5	5	16.0	2	0.5	5	16.0	2	0.5	5	16.0
M_1	36.6	-	-	-	-	14	3.6	6	19.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M_2	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M_3	11.3	-	-	-	-	1	0.3	9	28.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N	32.2[3/]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.8	16	51.2	-	-	-	-	-	-	-	-	-	-	-	-
O	30.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3	-	-	-	-	-	-	-	-	-	-
P	23.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.8	16	51.2	-	-	-	-	-	-	-	-	-	-	-	-
Q	90.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1.6	19	60.8
R	8.3[2/]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S	6.0[1/]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	20	5.5	85	265.6	33	8.7	81	259.2	13	3.4	102	326.4	21	5.5	76	243.2	19	5.0	78	249.6	20	5.3	76	243.2	25	6.6	97	310.4	26	6.9	97	310.4
	Total Acreage	271.1				267.9				329.8				248.7				254.6				248.5				317.0				317.3			

1/ S replaces C_2 in Step 3 analysis
2/ R replaces M_2 in Step 3 analysis
3/ Segments H and N were dropped during Step 3 analysis

Applicant's proposed, Trident-Boulder, Butte-Anaconda and Great Falls alternative corridors.

Another method of expressing the magnitude and relevance of this impact is to compare the relative economic loss resulting from the reduction in farmland. To do this, a higher economic value is placed on production removed from irrigated land (because of higher yields and sometimes higher value cash crops) than from dryland removed from production. Land values also are generally higher for irrigated acreages. For these reasons, a factor of two was used to adjust the irrigated land values of Table VII-13, providing the data presented in Table VII-14.

Table VII-14 - ADJUSTED AGRICULTURAL LAND IMPACT

CORRIDOR	LAND REMOVED FROM PRODUCTION Irrigated Acres	Dryland Acres	Total
APPLICANT'S PROPOSED	5.5 x 2 = 11.0	265.6	276.6
SIEGEL PASS	8.2 x 2 = 16.4	259.2	275.6
GREAT FALLS	4.5 x 2 = 9.0	310.4	319.4
HELENA (MACDONALD PASS)	5.8 x 2 = 11.6	244.2	254.8
HELENA (AVON VALLEY)	5.0 x 2 = 10.0	249.6	259.6
TOWNSEND-BOULDER	5.3 x 2 = 10.6	243.2	253.8
TRIDENT-BOULDER	6.6 x 2 = 13.2	310.4	323.6
BUTTE-ANACONDA	6.9 x 2 = 13.8	310.4	324.2

This adjustment does not alter the ranking of corridors. The Townsend-Boulder alternative remains the lowest rated for agricultural impact and the Great Falls alternative the highest. The Townsend-Boulder corridor scores 9 percent better than the Applicant's proposed corridor even though these two corridors are identical from Colstrip to Townsend. The difference in potential impact from Townsend to Hot Springs is due to crossing seven fewer miles of dryland farming areas via the Townsend-Boulder corridor.

Dollar values for the acreage removed from production can be estimated by combining data from Tables VII-13, III-6, and III-7. The estimated annual gross economic loss from reduced crop production on irrigated land would range from $461 (if all land were in oats) to $8,045 (if all were in potatoes) for the Townsend-Boulder corridor. Most irrigated lands along this corridor are seeded to cereal grains or hay, so a realistic estimated crop loss value for this corridor would be about $750-$1,500.

For dryland crops, the extremes in estimated average gross crop value loss would be $28,940 (all land in winter wheat, $119/A), and $13,860 (all land in oats, $57/A). Here, the higher value is probably more realistic because winter wheat is the primary crop produced in the area. This value could be reduced by about 40 percent, the proportion of dryland customarily in summer fallow each year.

Comparative values for the other corridors would be equivalent, percentagewise, to these as adjusted by the percent difference in acres of irrigated or nonirrigated farmlands crossed by each corridor.

Magnitudes of impact from building access roads and construction activities generally would be directly proportional to the miles of agricultural lands crossed. Generally, a certain number of access roads would be required regardless of the class of agricultural land crossed. Therefore, impact magnitudes from these activities would be in the same ranking as that described above for land removed by tower bases and guy lines. Differences could occur if more existing roads are used in one area than another, but most agricultural areas are supplied with numerous existing roads.

Project construction would probably result in crop production loss on the entire right-of-way for one season. For a 300-foot right-of-way, this would be 36.36 A/mi. Also, additional crop areas outside the right-of-way might be used for access and staging areas. Forty A/mi was estimated for this value. Thus, 40 A/mi times the miles of irrigated land crossed (22), times the crop value per acre ($130-260), provides an estimate of $114,400 to $228,000 of lost income from irrigated land on the Helena corridor. Non-irrigated crop production losses figured in the same way, but with a crop value of $119/A for winter wheat, would be about $362,000 during construction of the Helena corridor. Losses on other corridors would be proportionately greater, according to acreages removed from production.

Reduced crop production due to soil compaction, disturbance, or erosion would likely occur for two to three years beyond the construction period. Total combined crop losses during this period should be no greater than one-third the production of one normal crop. Therefore, crop production losses of $38,000 to $76,000 for irrigated land and $120,500 for drylands of the Helena corridor would be added to the loss from the construction period to provide a total value of estimated crop loss from construction phase activities.

The impact of interference with operation of automated irrigation equipment would likely be of small magnitude. Only a few miles of irrigated lands are crossed by each alternative corridor, and most fields are small and dispersed. Proper centerline placement and tower siting on wasteland should minimize this problem. In general terms, this impact would be directly proportional to the miles of irrigated land crossed.

An impact of considerable potential magnitude involves the use of large field equipment around towers and guy lines. No dollar value can be attached to this impact, but it is one which should be considered very seriously during centerline location. This problem would vary with each producer, depending on his farming practices and equipment used. Guyed towers create a particular hazard for aerial sprayers. Farmers who have strips laid out to accommodate equipment of specific widths or for contour farming would probably have the greatest difficulty.

No dollar value can be assigned to a "nuisance" impact. Most farms of the area are diversified, with many having livestock operations. Fences, gates, and other facilities would be encountered in any corridor. Crop damage may also result from construction and maintenance activities. These impacts would probably be proportional to the amount of agricultural land in each corridor.

The total impact on agriculture of constructing and maintaining a powerline would be a combination of individual impacts (see Figure VII-7). Since each impact is dependent on the distance or acreage of agricultural land crossed, the combined impact would be somewhat greater than that expressed by the data on Tables VII-13 or 14. However, because no quantitative value can be derived for some of the impacts, neither can a total impact value be obtained. Nevertheless, the results of the analysis favor the Townsend-Boulder alternative corridor, from the standpoint of potential impacts on agricultural activities only.

URBAN/RESIDENTIAL

Discussion

Generally, transmission lines are located away from urbanized areas (see Figure VII-8). If possible, lines are routed away from residences in non-urban areas as well. This minimizes land acquisition costs. Some short-term problems associated with construction activities near urban and residential developments include noise from machinery, dust, safety problems (an "attractive nuisance" for children), traffic congestion caused by the movement of construction equipment on the roadway, visual disturbances by construction machinery and activities, and various "nuisance" pollution (e.g., litter, parked vehicles of construction workers, etc.).

There are long-term conflicts arising from locating a transmission line near urban and residential land uses. Potential noise and electrical interference with radio and television reception, as discussed under "Electrical Considerations" (Chapter II), could be mitigated to a degree. Periodic maintenance inspections would continue for the life of the project, with possible problems similar to those arising during construction. Another potential impact to urban and residential land uses is the increased possibility that future lines would be located adjacent to the existing right-of-way. Other long-term nuisance impacts on urban and residential land use include unauthorized recreational use of the right-of-way (e.g., by off-road vehicles and motor bikes) with attendant noise, dust, and erosion and the increased likelihood trash and garbage

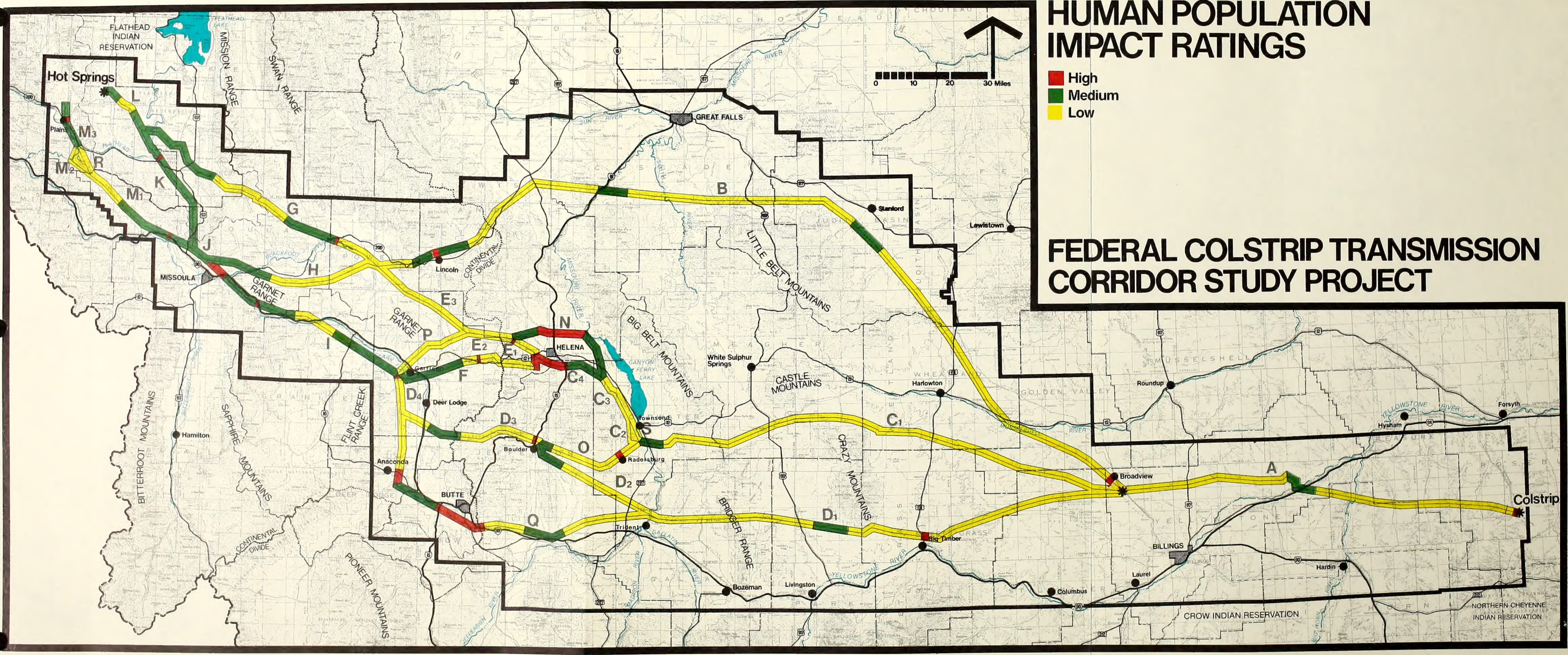
HUMAN POPULATION IMPACT RATINGS
🟥 High
🟩 Medium
🟨 Low
0 10 20 30 Miles
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
FLATHEAD INDIAN RESERVATION
FLATHEAD LAKE
MISSION RANGE
SWAN RANGE
Hot Springs
Plains
L
M3
M2
R
M1
K
G
J
H
MISSOULA
GARNET RANGE
Lincoln
CONTINENTAL DIVIDE
E3
P
E2
E1
N
HELENA
I
Garrison
F
C4
D4
Deer Lodge
C3
D3
Townsend
C2
Boulder
O
Radersburg
D2
Anaconda
BUTTE
Q
Trident
D1
Big Timber
C1
Broadview
A
Colstrip
GREAT FALLS
B
Stanford
Lewistown
LITTLE BELT MOUNTAINS
BIG BELT MOUNTAINS
CANYON FERRY LAKE
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
CRAZY MOUNTAINS
BRIDGER RANGE
Bozeman
Livingston
Columbus
Laurel
BILLINGS
Hardin
Roundup
Hysham
Forsyth
GOLDEN VALLEY
MUSSELSHELL
YELLOWSTONE RIVER
MISSOURI RIVER
SUN RIVER
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
BITTERROOT MOUNTAINS
SAPPHIRE MOUNTAINS
Hamilton
FLINT CREEK RANGE
CONTINENTAL DIVIDE
PIONEER MOUNTAINS
CHOUTEAU
TETON
FERGUS

Figure VII-8

would be dumped in the right-of-way. There would be an additional potential impact on special urban land uses such as schools, drive-in theatres, or airports. Should any of these land uses be located near the transmission line route, special mitigating measures would have to be undertaken.

Until a route is selected and surveyed, the number of residences and businesses directly affected by the line cannot be determined. However, the counties and other planning jurisdictions in the study area were contacted and, where possible, copies of the land use plans for their planning areas were obtained. The plans were examined to determine compatibility with transmission line routing, as discussed below.

Corridor Comparisons

Segment A, common to all the corridors, begins at Colstrip in Rosebud County and runs west into Treasure County. This portion of one transmission line has already been constructed. The Draft Rosebud County, Montana General Plan - 1976 does not include information on community expectations for land use and growth patterns. No assessment of the impact of this transmission line can be made.

Segment A also crosses the southern part of Treasure County. The Treasure County planning document (Cumin Associates 1977) includes a land use inventory for Hysham only. It does not contain any information on plans for accommodating urban growth or changes in rural land use.

Segment C_1 of the Applicant's proposed corridor and the Helena alternatives passes through Meagher County. The route passes close to the communities of Martinsdale and Ringling. The county land use plan specifically prohibits location of a residential use in a "hazardous area," which is defined to include high voltage powerlines. In addition, all urban land uses are to be excluded from flood hazard areas. Residential uses are to be screened from industrial uses (Meagher County Planning Board 1977). Line location would have to be compatible with existing residential development.

Comprehensive plans have been developed for the Helena area. The Helena jurisdictional area is crossed by segment C_4 of the Applicant's proposed corridor and of the Helena alternatives, by segment E_1 of the Applicant's proposed corridor and of the Helena (Avon Valley) corridor, and by F_1 of the Helena (MacDonald Pass) corridor. Segment N passes immediately outside the jurisdictional area. The plans suggest urban growth be encouraged near the airport (east of the Central Business District), to the west of the city, and to a limited extent in the North Valley area (north of the city). The city planners are especially concerned that the area south and southwest of the city should remain in as natural a state as possible. That area includes Mt. Helena Park and is considered a prime recreational area for the city. Residential development should be confined to a few places only (Consulting Services Corporation 1966; Mount Helena City Park Development and Management Plan, no date). Local planning agencies should be worked with closely to determine the optimum location for a line in this area.

A comprehensive plan has been developed for Jefferson County. Segment D_2 of the Trident-Boulder alternative, segment D_3 of the Townsend-Boulder and Trident-Boulder alternative, segments C_3 and C_4 of the Helena alternatives, and segment O of the Townsend-Boulder alternative, and segment Q of the Butte-Anaconda alternative all pass through the county. The county plan seeks to preserve and enhance the rural nature of the area with no drastic changes in the existing development patterns. Most of the development within the county has been residential. The northern part of the county serves primarily as a bedroom community for Helena; the plan recommends allocating land for future residential development on nonagricultural land in the northern part of the county and around existing developments (Daily-Peccia & Associates 1976). The plan does not suggest how transmission lines should be accommodated.

Segment Q of the Butte-Anaconda alternative crosses the Butte-Silver Bow city/county planning area, passing just south of the Silver Bow county airport which lies to the south of the city of Butte. According to the Butte-Silver Bow Land Use Plan, urban development in Butte will "occur south between the C. M. St. P. & P. Railroad on the west and Interstate Highway 90 on the east" (p. 6-1). Growth is funneled this way because mountains lie to the east and west. "The airport occupies a sizeable portion of the flats area and is faced with encirclement by development, though not likely in the 20-year period of the planning program" (Ibid, p. 6-1).

Deer Lodge County is crossed by segment Q of the Butte-Anaconda alternative. The route passes between the planning analysis zones designated as the Anaconda and Opportunity study areas in the Countywide Planning Report. The plan calls for residential areas to be buffered from incompatible land uses. Prime agricultural lands are to be protected from urban sprawl and "leap frog" development; more compact development in areas already served by utilities should be encouraged to protect the agricultural land resource. The plan for the Opportunity study area lumps the entire residential area into one classification with a two-acre minimum lot size in order to control subdivision activity. The Deer Lodge County Planning Board maintains the power of review and can channel growth in appropriate areas. The Anaconda City study area is the center of commercial activity for the county. General business expansion is occurring to the east of the city which is where the proposed Butte-Anaconda corridor would be located. The Anaconda Company smelter is east of the city limits, and that general area is considered a good location for industrial growth (Northwest Planners, Inc. 1973).

Segment I of the Helena alternative, the Townsend-Boulder alternative, Trident-Boulder alternative and the Butte-Anaconda alternative passes through the northernmost part of Granite County. Little growth is anticipated in the county. Any commercial and industrial expansion will probably be at existing sites. New year-round and seasonal homesites are the only major change anticipated in the county and these will most likely be developed near Drummond, which is near this segment (Granite County Planning Board no date). If this segment were chosen, compatibility with planned growth in Drummond would have to be closely examined.

A comprehensive land use plan has been developed for Missoula County. The county is crossed by six segments of the alternative corridors: segment G of the Applicant's proposed corridor and the Great Falls alternative; segment H of the Siegel Pass alternative; segment I of the

Helena, Townsend-Boulder, Trident-Boulder and Butte-Anaconda alternatives; segment J of the Helena, Siegel Pass, Townsend-Boulder, Trident-Boulder and Butte-Anaconda alternatives; and segment M_1 of the Siegel Pass alternative. Urban development in the county is shaped to a great extent by the geography of the area. The rugged mountainous areas restrict transmission line routing to the same river valleys that are most suited to urbanization. The general land use goals of the Missoula Planning Board are similar to those of other study area counties--to maintain environmental quality, to assure cost-effective expenditures for public facilities and services, to provide for the logical expansion of communities, and to protect agricultural and forestry operations from the adverse impact of urban development. Transmission line and/or utility corridors are not specifically accommodated. Segment G crosses "open and resource land". Segments H, I, and J cross what is designated as the "Missoula Urban Area". Segments K and M_1 both cross predominantly "open and resource land" interspersed with some "residential-rural low density" (maximum of one dwelling per ten acres) (Missoula City/County Planning Board 1975).

The southern part of Lake County is crossed by two segments of the corridors--segment G of the Applicant's proposed corridor and segment K of the Helena alternative, Townsend-Boulder, Trident-Boulder, and Butte-Anaconda alternatives. This area is part of the Flathead Indian Reservation, and land use planning for the area is developed under the auspices of the tribe rather than by the Lake County Planning Board. However, the residents of the Flathead Reservation hold many of the same values as the citizens in the rest of the county (Hall 1977). The county plan calls for maintenance of the rural way of life in the county and for preservation to the extent possible of prime farm lands and forested areas. Only about two percent of the land area in the county is developed to urban uses. The incompatibility of residential, commercial, and industrial uses is recognized, and growth and development of these uses is encouraged in and around existing towns and communities (Erickson 1977).

RECREATION

Discussion

Six primary categories of recreation impact that could result from the construction, operation and maintenance of twin 500-kV lines and their related support facilities (including communications control facilities and substations) have been identified. They are as follows:

1. Loss of existing and potential land and water-based developed recreation opportunities - This impact would directly affect the amount of land available for developed recreation sites, such as campgrounds, historic sites, National Register sites, state parks, marinas, private resorts, and other intensively developed areas. The loss in terms of acreage taken out of use would vary, depending upon the type of terrain crossed, the length of access road needed for the line, and the basic feasibility of developing the land for recreation use. The planned 300-foot right-of-way required for this project would, in gentle terrain, take about 36 acres per line mile. In mountainous areas where recreation use is high, and where the required project access road needs are also high, as much as 50 acres per line mile could be removed from developed recreation use if a minimum 200-foot buffer zone is allowed for the access roads outside the transmission line right-of-way.

2. Loss or displacement of existing or potential dispersed recreation use - Because most Montana recreationists prefer to pursue dispersed activities (i.e., hiking, hunting, fishing, driving for pleasure, etc.) in general undeveloped outdoor areas (MDFG 1973), they will probably avoid transmission rights-of-way areas when they have a choice.

   Of the possible 16,000 acres of transmission line right-of-way proposed, only about 475 acres needed for tower bases, substations, and microwave stations could, however, be considered an actual physical barrier to dispersed recreation use.

3. Reduction in the quality of the existing and potential recreation experience - would occur where the line, microwave control stations, or substations are visible from key recreation use areas. Views from wilderness and roadless areas would be especially important because of the high expectation for a "pristine" experience. This impact is also addressed in the "Visual Resources" section of this chapter.

4. Opening new recreation travel routes - Building new roads or improving existing ones may be viewed as a benefit to recreationists in some instances. One example of adverse impacts, however, would be penetration by off-road vehicles (4-wheel drives, motorcycles, and snowmobiles) into key elk, deer, and grizzly habitat areas.

5. Reduction in recreation land value - would occur on both private and public lands. To the private recreation enterprise, this could be a serious loss in terms of the actual dollar value of the land. On public lands, the presence of a large transmission line can, because of BOR policy (USDI 1973), virtually eliminate future options of the land manager to acquire or develop adjacent high quality recreation lands using Federal monies authorized under the Land and Water Conservation Fund Act.

6. Loss of income - would occur as a result of reduced recreation use and reduced recreation capital investment. The new income generated by the new energy sources made available by the project would probably overshadow potential income losses.

Table VII-15 shows the Colstrip data items and determinants (from Step 1, 2, and 3) that make up the total measured recreation resource values used to assess recreation impacts. Recreation impacts were assessed in Steps 1, 2, and 3 (Chapters IV, V, and VI). In each of these steps, specific recreation impacts were determined by overlaying all of the recreation resource values (data items) and weighing the combination of these high, medium, and low resource values to obtain the final Step 3 recreation impact determinant (see Figure VII-9).

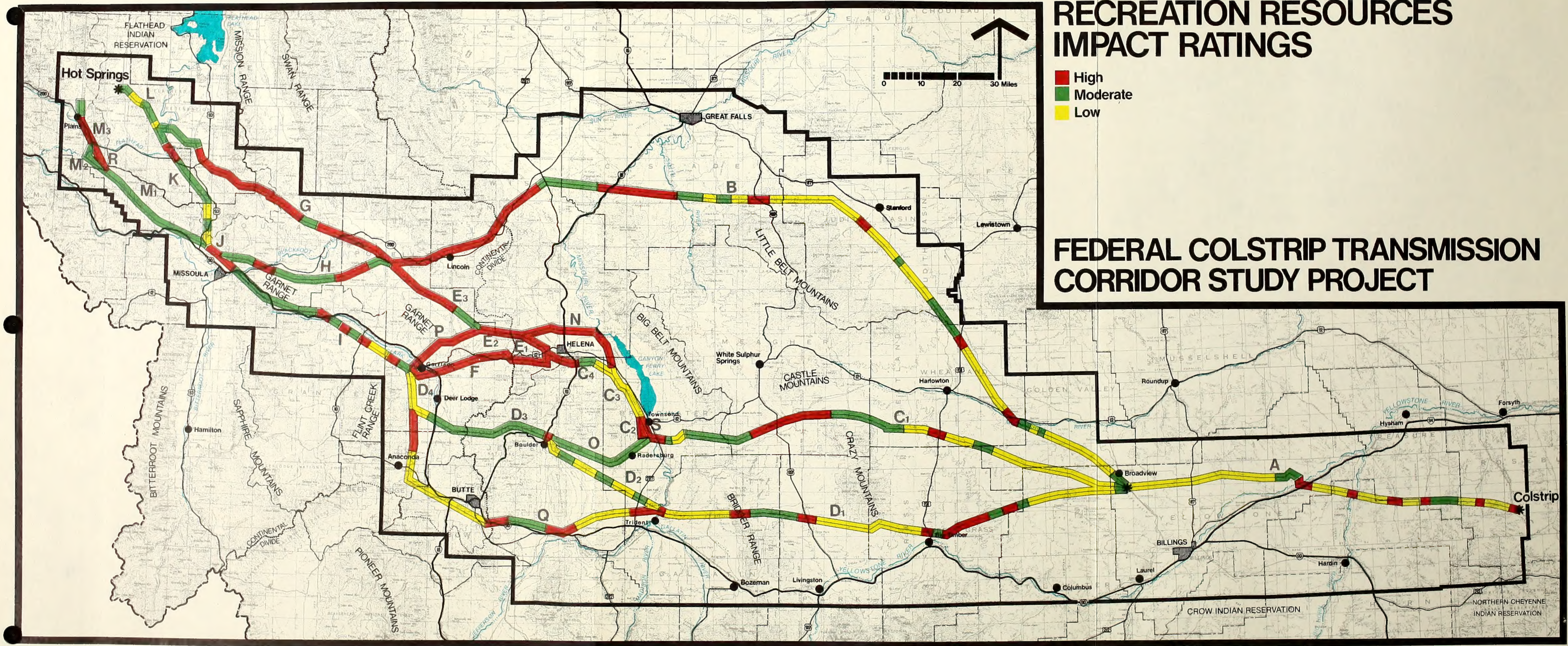

RECREATION RESOURCES IMPACT RATINGS
🟥 High
🟩 Moderate
🟨 Low
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
0 10 20 30 Miles
FLATHEAD INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
Hot Springs
Plains
GREAT FALLS
Stanford
Lewistown
Lincoln
CONTINENTAL DIVIDE
MISSOULA
GARNET RANGE
HELENA
CANYON FERRY LAKE
BIG BELT MOUNTAINS
LITTLE BELT MOUNTAINS
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
Roundup
Forsyth
Hysham
YELLOWSTONE RIVER
MISSOURI RIVER
Garrison
Deer Lodge
FLINT CREEK RANGE
Anaconda
BUTTE
Boulder
Townsend
Radersburg
Trident
BRIDGER RANGE
CRAZY MOUNTAINS
Big Timber
Broadview
Colstrip
BILLINGS
Laurel
Columbus
Hardin
Bozeman
Livingston
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
BITTERROOT MOUNTAINS
Hamilton
SAPPHIRE MOUNTAINS
PIONEER MOUNTAINS
A
B
C1
C2
C3
C4
D1
D2
D3
D4
E1
E2
E3
F
G
H
I
J
K
L
M1
M2
M3
N
O
P
Q
R
S

Figure VII-9

Table VII-15 - RECREATION IMPACTS

RECREATION IMPACTS	WATER BODIES/CLASS I & II FISHING STREAMS (# Crossed)	RECREATIONAL WATERWAYS (No. Crossed/Mi. paralleled)	STATE PARKS & RECREATION AREAS (exist & proposed)	SCENIC TRAVELWAYS (No. Crossed/Mi. paralleled)	HISTORIC TRAILS (No. Crossed/Mi. paralleled)	NATIONAL REGISTER AND HISTORIC SITES (No.)	WILDERNESS & PRIMITIVE AREA PROXIMITY (Mi.)	ROADLESS STUDY AREA PROXIMITY (Mi.)	NATURAL AREA PROXIMITY (Mi.)	FISH & WILDLIFE IMPACT POTENTIAL (Steps 1, 2, 3)	ELK WINTER RANGE/KEY ELK AREAS (Mi.)	MULE DEER & WHITE-TAILED DEER KEY AREAS (Mi.)	PROPOSED GRIZZLY CRITICAL HABITAT (Mi.)	SCENIC QUALITY (Mi. of High)	RECREATION SUITABILITY (Steps 1, 2, 3)	RECREATION RESOURCE IMPACT DETERMINANT (Steps 1, 2, 3)	VISUAL RESOURCE DETERMINANT (Steps 1, 2, 3)	ADJUSTMENT FOR PARALLELING EXIST. TRANS. CORR. (Steps 2 & 3)
	RECREATION RESOURCE VALUES																	
1. Loss of existing and potential land and water based recreation resources	X	X	X	-	-	X	-	-	-	X	X	X	X	-	X	X	-	X
2. Loss of displacement of existing and potential dispersed recreation experience	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3. Reduction in the quality of the existing and potential recreation experience	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4. Opening new recreation travel routes	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	X	X
5. Reduction in recreation land values	X	X	X	X	X	X	X	X	X	-	-	-	-	X	X	X	X	X
6. Loss of income	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table VII-16 - RECREATION IMPACT SUMMARY

CORRIDOR SEGMENT	LENGTH (in miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATION WATERWAYS* (# crossed/miles parallel)	STATE PARKS AND RECREATIONAL AREAS (existing/proposed)	SCENIC TRAVELWAYS (# crossed/miles paralleled*)	WILDERNESS & PRIMITIVE AREA PROXIMITY** (incl. potential study area)	ROADLESS STUDY AREA PROXIMITY (# crossed/miles paralleled)**	NATURAL AREA PROXIMITY (# crossed/miles paralleled**)	SCENIC QUALITY (miles high quality crossed)	NATIONAL REGISTER & HISTORIC SITES	HISTORIC TRAILS (# crossed/miles paralleled*)	ELK WINTER RANGE/KEY ELK AREAS (miles key forested area*)	MULE AND WHITE-TAILED DEER (miles key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (miles)
A x	111.4	59/0	18/11	1/ 6	14/10	0/0	0/0	0/1	13	2	0/ 0	0/ 0	0	0
B	241.8	155/0	58/68	27/14	32/57	0/0	7/7	1/0	45	4	2/ 0	2/ 0	2	17
C_1 x	134.2	56/1	23/48	11/ 7	21/41	0/0	2/0	1/0	12	0	1/20	0/ 0	1	0
C_2	7.0	1/0	1/ 0	0/ 2	2/ 0	0/0	0/0	0/0	4	0	0/ 0	0/ 0	0	0
C_3 x	13.2	5/0	3/ 5	0/ 4	1/13	1/0	1/0	0/0	0	1	0/ 0	0/ 0	0	0
C_4 x	20.1	4/0	2/ 0	4/ 5	2/ 5	1/0	0/0	0/0	0	17	0/ 7	0/ 1	0	0
D_1	130.7	72/0	22/79	6/ 9	21/64	0/0	2/0	0/0	17	0	1/ 4	2/ 0	2	0
D_2	35.7	17/0	7/15	1/ 3	4/21	0/1	0/2	0/0	1	0	0/ 0	0/ 0	0	0
D_3	39.2	14/0	7/24	6/ 5	7/10	0/0	1/1	0/0	14	1	0/ 0	4/12	0	0
D_4	10.7	7/0	4/ 1	0/ 0	0/ 0	0/0	1/0	0/0	0	0	0/ 0	0/ 0	0	0
E_1 x	8.3	3/0	2/ 1	1/ 0	1/ 0	0/0	0/1	0/0	0	1	1/ 1	0/ 0	0	0
E_2 x	11.2	3/0	3/ 5	1/ 0	1/ 4	0/0	0/1	0/0	11	1	1/ 2	0/ 0	0	0
E_3 x	32.5	10/0	9/24	2/ 4	5/30	0/0	0/2	0/0	33	1	0/ 0	2/ 0	1	0
F	42.7	11/0	8/19	5/ 9	8/20	0/0	3/0	0/0	20	3	3/22	6/ 0	1	0
G x	78.3	38/0	12/87	11/10	11/39	0/1	0/1	0/0	72	4	0/ 0	8/ 0	3	0
H	48.5	15/1	7/21	5/ 2	5/ 4	1/0	1/1	0/0	5	0	0/ 0	1/ 0	0	15
I	61.2	26/1	10/55	7/14	13/30	0/1	1/0	0/0	0	5	0/ 0	0/ 0	1	0
J	4.7	2/0	3/ 0	0/ 0	0/ 0	0/0	0/1	0/0	0	0	0/ 0	0/ 0	0	0
K	35.7	21/0	4/37	2/ 4	7/24	0/0	0/1	0/0	3	1	0/ 0	1/ 0	0	0
L x	16.1	9/0	3/ 9	0/ 2	2/ 6	0/0	0/0	0/0	0	0	0/ 0	0/ 0	0	0
M_1	36.6	33/0	8/36	1/ 4	3/26	0/0	0/0	0/0	0	5	0/ 0	16/ 2	0	0
M_2	9.3	7/0	1/ 6	1/ 2	2/15	0/0	3/0	0/0	0	3	0/ 0	0/ 0	0	0
M_3	11.3	4/0	1/12	0/ 1	1/23	0/0	2/0	0/0	6	0	0/ 0	2/ 0	0	0
N	32.2	12/0	5/26	1/21	8/ 0	0/0	0/2	0/0	0	0	3/ 1	0/ 0	0	0
O	30.0	14/0	5/ 0	1/ 1	2/ 0	0/1	1/1	0/0	19	1	0/ 0	9/ 0	9	0
P	23.6	7/0	5/ 2	1/ 2	1/ 6	0/0	0/1	0/0	4	15	1/ 0	0/ 0	0	0
Q	90.7	35/0	15/21	5/10	12/24	0/0	1/2	1/0	17	2	0/ 0	2/ 0	0	0
R	8.3	1/0	1/ 0	0/ 0	2/ 4	0/0	1/2	0/0	4	1	0/ 0	0/ 0	0	0
S x	6.0	0/0	1/ 6	1/ 3	2/20	0/0	0/0	0/0	0	0	0/ 0	0/ 0	0	0

* Paralleling is measured if within 3 miles of the corridor center.

** "Crossing" is counted if within 2 miles of the corridor center; paralleling is measured if within 2-6 miles of the corridor center.

x Applicant's Proposed Corridor.

Table VII-17 - RECREATION IMPACT PER MILE

CORRIDOR SEGMENT	LENGTH (in miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATIONAL WATERWAYS* (# crossed/miles parallel)	STATE PARKS AND RECREATIONAL AREAS (existing/proposed)	SCENIC TRAVELWAYS (# crossed/miles paralleled*)	WILDERNESS & PRIMITIVE AREA PROXIMITY** (includes potential study areas)	ROADLESS STUDY AREA PROXIMITY** (# crossed/miles paralleled)	NATURAL AREA PROXIMITY (# crossed/miles paralleled)	SCENIC QUALITY (miles of high quality crossed)	NATIONAL REGISTER & HISTORIC SITES	HISTORIC TRAILS (# crossed/miles paralleled*)	ELK WINTER RANGE/KEY ELK AREAS (miles key forested area*)	MULE DEER AND WHITE-TAILED DEER (miles key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (miles)	TOTAL IMPACT PER MILE SCORE	IMPACT RATING 1- highest 28- lowest
A x	111.4	.53	.17	.07	.22	0	0	.01	.12	.02	0	0	0	0	1.14	28
B	241.8	.64	.52	.17	.37	0	.06	0	.19	.02	.01	.01	.01	.07	2.07	17
C_1 x	134.2	.42	.53	.13	.46	0	.01	.01	.09	0	.16	0	.01	0	1.82	21
C_2	7.0	.14	.14	.29	.29	0	0	0	.57	0	0	0	0	0	1.43	25
C_3 x	13.2	.38	.61	.31	1.06	.08	.08	0	0	.08	0	0	0	0	2.60	11
C_4 x	20.1	.20	.10	.45	.35	.05	0	0	0	.85	.35	.05	0	0	2.40	14
D_1	130.7	.55	.77	.11	.65	0	.01	0	.13	0	.04	.02	.02	0	2.30	15
D_2	35.7	.48	.62	.11	.70	.03	.06	0	.03	0	0	0	0	0	2.03	18
D_3	39.2	.36	.79	.28	.43	0	.05	0	.36	.03	0	.41	0	0	2.71	10
D_4	10.7	.66	.47	0	0	0	.10	0	0	0	0	0	0	0	1.23	27
E_1 x	8.3	.36	.36	.12	.12	0	.12	0	0	.12	.24	0	0	0	1.44	24
E_2 x	11.2	.27	.71	.09	.45	0	.09	0	1.00	.09	.27	0	0	0	2.97	8
E_3 x	32.5	.31	1.02	.18	1.08	0	.06	0	1.02	.03	0	.06	.03	0	3.79	5
F	42.7	.26	.63	.33	.66	0	.07	0	.47	.07	.59	.14	.02	0	3.24	7
G x	78.3	.49	1.26	.27	.64	.01	.01	0	.92	.05	0	.10	.04	.19	3.98	4
H	48.5	.33	.58	.14	.19	0	.04	0	.10	0	0	.02	0	0	1.40	26
I	61.2	.44	1.06	.34	.54	.02	.02	0	0	.08	0	0	.02	0	2.52	12
J	4.7	.64	.64	0	0	0	.21	0	0	0	0	0	0	0	1.49	23
K	35.7	.59	1.15	.17	.87	0	.03	0	.08	.03	0	.03	0	0	2.95	9
L x	16.1	.56	.75	.12	.50	0	0	0	0	0	0	0	0	0	1.93	19
M_1	36.6	.90	1.20	.14	.79	0	0	0	0	.14	0	.49	0	0	3.66	6
M_2	9.3	.75	.75	.32	1.83	0	.32	0	0	.32	0	0	0	0	4.29	3
M_3	11.3	.35	1.15	.09	2.12	0	.18	0	.53	0	0	.18	0	0	4.60	2
N	32.2	.37	.96	.68	.25	0	.06	0	0	0	.12	0	0	0	2.44	13
O	30.0	.47	.17	.07	.07	.03	.07	0	.63	.03	0	.30	.30	0	2.14	16
P	23.6	.30	.30	.13	.30	0	.04	0	.17	.64	.04	0	0	0	1.92	20
Q	90.7	.39	.40	.17	.40	0	.03	.01	.19	.02	0	.02	0	0	1.63	22
R	8.3	.12	.12	0	.72	0	.36	0	.48	.12	0	0	0	0	1.92	20
S x	6.0	.17	1.17	.67	3.67	.04	0	0	0	0	0	0	0	0	5.68	1

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* Paralleling is measured if within 3 miles of the corridor center.

** "Crossing" is counted if within 2 miles of the corridor center; paralleling is measured if within 2-6 miles of corridor center.

x Applicant's Proposed Corridor.

Each of the several recreation values assessed for recreation impacts will probably be considered very significant by someone. Consequently, the following "raw" numerical corridor and corridor segment comparisons were made to give a picture of "how much" of a particular recreation resource would be impacted along a given corridor segment or primary corridor (see Tables VII-16, VII-17, VII-18, VII-19, VII-20). These comparisons supplement the final, Step 3, Colstrip recreation impact assessment.

Tables VII-16 and VII-19 show the numbers of recreation resources intersected by, paralleled by, and located adjacent to the Applicant's proposed corridor and the alternative corridors. Tables VII-17 and VII-20 show the per mile impact for each recreation resource value. For example, under column 4 (recreational waterways) for segment A, 8 waterways are crossed and 11 miles of waterways paralleled (see Table VII-16). The

Table VII-18 - RECREATION IMPACTS

		DATA ITEM SCORE (miles)			
CORRIDORS	LENGTH (in miles)	HIGH	MODERATE	LOW	% DIFFERENCE FROM APPLICANTS
APPLICANT'S PROPOSED	431.3	171.6	110.6	149.1	0
SIEGEL PASS	446.3	156.3	148.9	141.1	+1
GREAT FALLS	447.6	161.9	105.8	179.9	-1
HELENA (MACDONALD PASS)	445.3	143.1	137.7	164.5	-4
HELENA (AVON VALLEY)	445.7	127.9	153.3	164.5	-7
TOWNSEND-BOULDER	443.2	86.7	198.8	157.7	-14
TRIDENT-BOULDER	445.4	87.4	166.1	191.9	-17
BUTTE-ANACONDA	461.2	118.9	123.7	218.6	-10

Table VII-19 - RECREATION IMPACT SUMMARY: MEASURED IMPACTS

CORRIDORS	LENGTH (in miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATION WATERWAYS (# crossed/mi. paralleled*)	STATE PARKS & RECREATION AREAS (existing & potential)	SCENIC TRAVELWAYS (# crossed/mi. paralleled*)	WILDERNESS & PRIMITIVE AREA PROXIMITY**	ROADLESS STUDY AREA PROXIMITY**	NATURAL AREA PROXIMITY**	SCENIC QUALITY (mi. of high quality crossed)	NATIONAL REGISTER SITES & HISTORIC SITES	HISTORIC TRAILS (# crossed/mi. paralleled)	ELK WINTER RANGE/KEY ELK AREAS (mi. key forested area)	MULE DEER & WHITE-TAILED DEER (mi. key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (mi. crossed)
APPLICANT'S PROPOSED	431.3	187/1	110/196	32/41	60/168	2/1	3/5	1/1	111	27	3/23	12/1	5	15
SIEGEL PASS	446.3	195/2	81/169	27/36	58/180	3/0	7/8	1/1	84	29	3/30	21/3	3	0
GREAT FALLS	447.6	261/0	91/175	39/32	59/112	0/1	7/8	1/1	130	10	2/0	10/0	5	32
HELENA (MACDONALD PASS)	445.3	193/2	75/190	31/54	70/169	2/1	4/4	1/1	48	29	4/49	7/1	3	0
HELENA (AVON VALLEY)	445.7	195/2	77/179	29/51	65/159	2/1	4/5	1/1	43	43	4/30	1/1	2	0
TOWNSEND-BOULDER	443.2	208/2	77/185	28/39	66/121	0/2	6/4	1/1	61	10	1/20	14/12	2	0
TRIDENT-BOULDER	445.4	227/2	78/231	24/43	68/165	0/2	5/5	0/1	48	9	1/4	7/12	3	0
BUTTE-ANACONDA	461.2	231/2	79/213	21/45	69/158	0/1	5/4	1/1	64	10	1/4	5/0	3	0

*Paralleling is measured if within 3 miles of the corridor center.

**Crossing is counted if within 2 miles of the corridor center; paralleling is measured if within 2-6 miles of the corridor center.

Table VII-20 - RECREATION IMPACT SUMMARY - IMPACT PER MILE

CORRIDORS	LENGTH (in miles)	WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	RECREATION WATERWAYS (# crossed/mi. paralleled*)	STATE PARKS & RECREATION AREAS (existing & potential)	SCENIC TRAVELWAYS (# crossed/mi. paralleled*)	WILDERNESS & PRIMITIVE AREA PROXIMITY**	ROADLESS STUDY AREA PROXIMITY**	NATURAL AREA PROXIMITY**	SCENIC QUALITY (mi. of high quality crossed)	NATIONAL REGISTER SITES & HISTORIC SITES	HISTORIC TRAILS (# crossed/mi. paralleled)	ELK WINTER RANGE/KEY ELK AREAS (mi. key forested area)	MULE DEER & WHITE-TAILED DEER (mi. key forested area)	PROPOSED GRIZZLY BEAR CRITICAL HABITAT (mi. crossed)
APPLICANT'S PROPOSED	431.3	.44	.71	.17	.53	.0069	.019	.0046	.26	.06	.06	.03	.01	.04
SIEGEL PASS	446.3	.44	.56	.14	.53	.0067	.034	.0045	.19	.07	.07	.05	.01	--
GREAT FALLS	447.6	.58	.59	.16	.38	.0022	.034	.0045	.29	.02	.01	.02	.01	.07
HELENA (MACDONALD PASS)	445.3	.44	.60	.19	.54	.0067	.018	.0022	.12	.07	.12	.02	.01	0
HELENA (AVON VALLEY)	445.7	.44	.57	.18	.50	.0067	.020	.0045	.10	.10	.08	.01	.01	0
TOWNSEND-BOULDER	443.2	.47	.59	.15	.42	.0045	.023	.0045	.14	.02	.05	.06	.01	0
TRIDENT-BOULDER	445.4	.51	.69	.15	.52	.0044	.022	.0022	.11	.02	.01	.04	.01	0
BUTTE-ANACONDA	461.2	.51	.63	.14	.49	.0021	.020	.0043	.14	.02	.01	.01	.01	0

*Paralleling is measured if within 0-3 miles of the corridor center

*Crossing is counted if within 2 miles of the corridor center; paralleling is measured if within 2-6 miles of the corridor center total impact per mile score was calculated: 8 + 11 = 19; 19 ÷ 111.4 (Segment length) = 0.17 per mile impact for recreation waterways for segment A. (For the purposes of this study, one "crossing" is equivalent to one mile.) The total per mile impact score was computed for each segment; each segment was ranked (1 the highest and 28 the lowest) according to the final impact scores.

The above tables provide a good "numerical picture" of the measured recreation impacts used in Step 3, but they do not reflect the total, overlapping, cumulative effect of high, medium, and low values as displayed in Figure VII-9.

Corridor Comparisons

The Siegel Pass Alternative - This corridor, with a recreation impact score of 2118 (see Table VI-6) appears to have the greatest potential impact on recreation resources. It parallels 180 miles of scenic travelways, more than any other corridor. It would also have a very high impact on scenic quality, intersecting 84 miles rated high for scenic values. Passing near (within 2 miles) of 29 National Register sites and paralleling 30 miles of historic trail, this corridor has one of the highest potential impacts on recreation and historic resources.

In that this alternative crosses within 2 miles of three classified wilderness areas, it has the highest rating for wilderness proximity impact. It also has one of the highest ratings for impact on roadless areas by crossing within 2 miles of seven such areas and within 2-6 miles of another eight. In contrast, however, the Siegel Pass corridor would have a comparatively moderate to low impact on state parks and recreation areas, crossing within 2 miles of twenty-seven of these intensively used areas.

The Applicant's Proposed Corridor - The Applicant's corridor has high to moderately high impact ratings for all of the recreation resources. With a recreation impact score of 2102, this corridor would have the second highest impact on recreation resources. It has the highest rating for impact on key recreation waterways, crossing 110 miles and paralleling 196 miles of these.

The Applicant's corridor has the second highest rating for potential impact on areas of high scenic quality, crossing 111 miles of high quality rated areas. Driving for pleasure, walking for pleasure, and sight-seeing together are the highest-use recreation activities pursued in Montana. This corridor also has a moderate to high rating for impact on National Register sites, and historic trails. It would intersect 27 National Register sites and historic sties, cross historic trails three times and parallel 23 miles of historic trails. Passing near three wilderness areas, the Applicant's corridor has one of the highest impact ratings for wilderness proximity.

The Great Falls Alternative - With a recreation impact score of 2078, this corridor would appear to have only slightly less impact (1%) than the Applicant's corridor. It has the highest rating for impact on water bodies crossed (261 crossings) and, for impact on recreation waterways crossed (91), is second only to the Applicant's proposed corridor which crosses 110. This corridor has the highest rating for impact on scenic quality, crossing 130 miles rated high for scenic quality.

This corridor has one of the highest impact ratings for roadless area proximity (it passes within 2 miles of four roadless study areas and within 2-6 miles of eight roadless study areas). It does however, have on the of the lowest impact ratings for wilderness area proximity (coming with 2-6 miles of only one existing wilderness area). It also has the lowest rating for impact on scenic travelways, crossing these only 59 times and paralleling 112 miles. It also has one of the lowest ratings for impact on National Register sites and historic trails, intersecting only 10 of the former and crossing only 2 of the latter.

The Helena (MacDonald Pass) Alternative - With a recreation impact score of 2015, this corridor would have 4% less recreation impact than the Applicant's proposed corridor, making it the fifth best from a recreation standpoint. It has one of the lowest ratings for impact on recreation waterways crossed and paralleled and water bodies crossed. It is also rated lowest for roadless area proximity and for impacts on scenic quality. It crosses only 48 miles rated high for scenic quality and crosses within 2 miles of four roadless areas and with 2-6 miles of four roadless areas.

The corridor does, however, have one of the highest recreation impact per mile ratings for existing and potential recreation areas and scenic travelways. It intersects 31 recreation sites (within 2 miles) and comes close to 54 (within 2-6 miles). It crosses 70 recreation travelways and parallels a total of 169 miles of these travelways. It also crosses 4 major historic trails and parallels a total of 49 miles of historic trail, making it the highest rated corridor for impact on historic trails. Passing within 2 miles of two wilderness study areas, and within 2-6 miles of one wilderness study area, this alternative also has one of the highest ratings for wilderness study area proximity.

The Helena (Avon Valley) Alternative - With a recreation impact score of 1955, this corridor would have 7% less impact than the Applicant's corridor. This alternative would be the fourth best from a recreation standpoint. It has one of the lowest ratings for impact on water bodies and recreation waterways. It also has the lowest impact rating for areas of high scenic quality, crossing only 43 miles. This corridor does have, however, a moderate to high rating for impact on existing and potential recreation areas, scenic travelways, and proximity to wilderness and roadless study areas. It passes within 2 miles of two wilderness study areas and four roadless study areas and within 2-6 miles of one wilderness study area and five roadless study areas. It also has the highest rating of all the corridors for impact on National Register sites, and one of the highest ratings for impact on historic trails. Forty-three National Register sites and four historic trails are crossed, and 34 miles of these trails are paralleled.

The Butte-Anaconda Alternative - With a recreation impact score of 1884, this corridor would have 10% less recreation impact than the Applicant's corridor, making it the third best recreation choice. This corridor has the lowest rating for impact on existing and potential recreation sites. In spite of its greater lenght (461.2 miles), it crosses only 10 National Register and historic sites, and only one historic trail. Although it crosses fewer key recreation waterways.

Along with the Townsend-Boulder and Trident-Boulder alternatives, this corridor crosses a Federal Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation) recreation composite located in the Flathead Pass area near Bozeman in the Bridger Mountains (crossed by segment D).

This corridor's impact on recreation travelways is rated moderate. Its impact on scenic quality is rated low to moderate, with only 64 miles rated high. This corridor also has the lowest level of proximity to wilderness and roadless study areas.

Townsend-Boulder Alternative - Possibly the second best choice in terms of recreation impact, this corridor is rated 14% lower for impact than the Applicant's proposed corridor. It also has one of the lowest ratings for impact on existing and potential recreation sites, scenic travelways, National Register sites, and historic sites. Its proximity to wilderness and roadless areas is moderate to high (it comes within 2 miles of six roadless areas and within 2-6 miles of four other roadless study areas, and within 2-6 miles of one wilderness study area). This corridor has a moderate rating for impact on historic trails. It crosses only one trail, but parallels 20 miles of historic trail.

The Trident-Boulder Alternative - With an impact score of 1748 (see Table VI-6), this corridor would have 17% less recreation impact than the Applicant's corridor, making it the best recreation corridor choice. It would have one of the lowest impacts on scenic quality, National Register sites, designated natural areas, and state parks and recreation areas (it crosses only 48 miles rated for scenic quality, intersects only 9 National Register and historic sites, passes within 2-6 miles of one designated natural area, and passes within 2 miles of only 24 state parks and recreation areas). It also has one of the lowest impact ratings for wilderness and roadless area proximity -- it passes within 2-6 miles of two designated wilderness and primitive areas, within 2 miles of five roadless areas, and within 2-6 miles of vie other roadless areas.

This corridor does, however, have a moderate to high impact rating for total water bodies crossed and paralleled, recreation waterways crossed and paralleled, and scenic travelways crossed and paralleled.

RIGHTS-OF-WAY

Discussion

All of the corridors parallel existing transmission lines to some extent. As stated in Chapter II, the proposed 500-kV lines are of a completely different nature (lattice steel structures) than the typical H-frame woodpole used elsewhere by Montana Power Company. Corridors D_4, I, J, K, L and Q parallel the BPA Hot Springs - Anaconda 230-kV line that is composed of a section, approximately 36 miles long, of steel structures and two sections of 54 miles and 53 miles of H-frame poles north and south of the steel towers. Table VII-21 lists existing lines parallelled (within a 2-mile wide corridor) for each alternative.

The disparity in right-of-way width and tower size between the proposed line and the existing lines, reduces the advantage of paralleling existing lines. Paralleling could, however, be useful in mountainous or forested terrain to reduce the extent of new access road construction and clearing. Most existing roads, however, would need upgrading to handle the much larger construction equipment needed for the 500-kV lines. Paralleling existing roads and highways would also reduce the impacts of new access road construction.

Crossing existing transmission lines and pipelines should not create any impacts. Railroad signals or communication systems crossed or paralleled could be affected unless adequately mitigated (see discussion on electrical effects). The main effect of crossing or paralleling highways is the visual impact on passing motorists.

Several sections of some corridors have space limitations, which could be a problem if the corridor selected for this project is to be considered in the future to accommodate additional lines or higher voltages.

Corridor Comparisons

The corridors vary in miles of existing lines paralleled, miles of commercial forest land crossed, and proximity to scenic travelways

Table VII-21 - EXISTING TRANSMISSION LINES PARALLELED

CORRIDORS	LENGTH (in miles)	POTENTIAL FOR PARALLELING								COMMERCIAL FOREST LAND CROSSED		SCENIC TRAVELWAYS CROSSED/ PARALLEL
		EXISTING LINES (kV)						TOTAL				
		100	161	230	100/ 230	161/ 230	100/ 161/ 230	MILES	%	MILES	%	NO/MILES
APPLICANT'S PROPOSED	431.3	26.5	0	205.9	0	0	0	232.4	54	91.8	21	60/168
SIEGEL PASS	446.3	38.3	20.0	111.4	0	0	4.7	174.4	39	106.1	24	50/180
GREAT FALLS	447.6	0	0	335.4	36.0	0	0	371.4	83	94.7	21	59/112
HELENA (MACDONALD PASS)	445.3	25.8	0	152.8	0	10.4	65.9	254.9	57	49.8	11	65/159
HELENA (AVON VALLEY)	445.7	25.8	0	152.8	0	10.4	65.9	254.9	57	63.3	14	70/169
TOWNSEND-BOULDER	443.2	0	0	152.8	0	21.1	65.9	239.8	54	73.5	17	66/121
TRIDENT-BOULDER	445.4	80.0	0	152.8	0	21.1	65.9	319.8	72	66.6	15	68/165
BUTTE-ANACONDA	461.2	80.0	0	152.8	0	86.2	65.9	384.9	83	50.0	11	69/158

(Table VI-6). Impacts or benefits cannot be accurately determined because so many variables are involved. For instance, with respect to terrain, visual values differ between flat and mountainous terrain. Whether the terrain is forested is also important. As mentioned above, should a smaller line be paralleled, upgrading existing access roads may involve as much as building new ones.

Overall, for this project, impacts from clearing and road construction should be reduced by paralleling existing utility and transportation corridors. However, introducing an entirely new structural design in this area would create a visual intrusion.

SPECIALLY MANAGED AREAS

The potential impacts on each of the data items included under Specially Managed Areas are discussed separately. Impacts associated with game refuges and ranges are discussed in the "Fish and Wildlife" section of this chapter. Impacts related to state parks and recreation areas, and scenic travelways and recreation waterways are covered in the "Recreation Resources" section of this chapter.

Wilderness/Primitive Areas

Although none are crossed by either the Applicant's proposed corridor or the alternative corridors, the proximity of the lines and supporting facilities to existing wilderness was regarded as a significant impact. Proximity impacts are assessed under "Recreation" in this chapter.

New Wilderness Study Areas

Corridor Segment H, part of the Applicant's proposed alternative corridor, passes through public land which is a potential wilderness study area. This area is located in the Wales and Yourname drainages of the Blackfoot River. The Bureau of Land Management is deferring action on any proposal that would change the wilderness character of the land until a wilderness study can be completed for the area. Corridor relocation would be required to avoid this area. None of the current new wilderness study proposed corridor or the alternatives. However, proximity to them is assessed under "Recreation" in this chapter.

Roadless Areas

Portions of several RARE II Roadless Areas are within the 2-mile wide corridors. However, most of these roadless areas could be avoided by locating the transmission centerline outside the roadless boundary, but still within the corridor.

Corridor Segment B (Great Falls Alternative): traverses the southeastern corner of Roadless Area 1-485, west of Rogers Pass, and the northern edge of Roadless Area 1-605, approximately seven miles west of Lincoln. These roadless areas could be avoided during centerline location.

Corridor Segment C (Applicant's Proposed Corridor and the Siegel Pass and both the Helena Alternatives): common to all five corridors, passes along the northern end Roadless Area 1-742, three miles south of Lennep. The roadless area could be avoided by locating the transmission centerline to the north of the roadless boundary.

Corridor Segment D (Butte-Anaconda and the Trident-Boulder Alternatives): traverses the northern end of Roadless Area 1-543 in the Bridger Mountains, 20 miles north of Bozeman. The roadless area could be avoided by following the existing powerline corridor through Flathead Pass if there is room for expansion, or if the existing lines can be combined with the proposed 500-kV lines on specially designed towers.

Corridor Segment F (Helena (MacDonald Pass) Alternative): runs along the north edge of Roadless Areas 1-607 and 1-608, 9 to 13 miles west of Helena. The transmission centerline could be located to the north of these roadless areas and still remain within the 2-mile wide corridor.

Corridor Segment M (Siegel Pass Alternative): The western end of this corridor segment is threaded between Roadless Areas 1-794, 1-795, and

1-796, which lie approximately five miles south of Paradise. Roadless Area 1-794 could be avoided in centerline location by staying near the Clark Fork River. Impacting Roadless Areas 1-795 and 1-796 could not be avoided as these two roadless areas are separated by only a narrow road along Siegel Creek, where there is not enough room to construct parallel 500-kV powerlines.

Administrative action on an application for a transmission line that would infringe upon a roadless area would have to be deferred until the Roadless Area Review and Evaluation (RARE II) process and the land use planning are completed. This could take up to three years.

Proximity to roadless areas, also regarded as a significant impact, is assess under "Recreation" in this chapter.

Natural Areas

Only one of the identified natural areas in the study area is located within any of the corridors (see Figure VII-10). Crossed by segment F, of the Helena (MacDonald Pass) alternative, it is located approximately seven miles west of Helena. The corridor passes over one of the near-pristine or relict vegetation communities identified by the USDA, Soil Conservation Service (Ross, et al. 1973). Disturbance of the site could be avoided entirely by locating the centerline of the transmission line away from this area.

Wild and Scenic Rivers

No designated wild and scenic rivers were encountered within the study area. Waterways or sections of waterways within the study area that may become so designated are included under "Recreation" in this chapter.

Management Objectives for Specified Areas

Corridor segment C (Applicant's proposed corridor and the Siegel Pass and both the Helena alternatives) passes through the Colorado-Unionville-Travis Planning Unit of the Helena National Forest. The management guidance does not specifically exclude new power transmission lines, but new lines would not be compatible with the management goals for the area. The proposed management plan, as detailed in the Draft Environmental Statement for the planning unit, features wildlife habitat, watershed considerations, scenic values from Helena and surrounding areas, and dispersed nonmotorized recreation. A transmission line corridor through this area would conflict with these management goals.

Corridor segment D (Butte-Anaconda and the Trident-Boulder alternatives) passes through two planning units: the North Bridger Planning Unit on the Gallatin National Forest and the Basin Planning Unit on the Deerlodge National Forest. In the North Bridger Unit, the only available space is in or immediately adjacent to the existing transmission line corridors. The corridor west of Flathead Pass is narrow, with very steep topography and shallow soils. Limestone rock outcrops are common. Road access to each tower site might not be permitted because of the land damage that could occur. The land management plan directs that the existing right-of-way be utilized for additional powerlines.

The management direction for the portion of the Basin Planning Unit that would be impacted by segment D is to manage the vegetative cover to maintain or enhance wildlife and to protect the aesthetic qualities of the area. Emphasis will be on maintaining winter range for deer and elk. Although no management guidance would prohibit the introduction of transmission lines, this activity could be in conflict with the management direction.

Corridor segment E (Applicant's proposed corridor and Siegel Pass alternative) traverses the Ophir-Dog-MacDonald Pass Planning Unit on the Helena National Forest. The location of this corridor link is not inconsistent with the management direction given for the area crossed.

Corridor segment F (Helena (MacDonald Pass) alternative) traverses the same management units in the Colorado-Unionville-Travis Planning Unit as Corridor segment C, and the same concerns apply, as discussed above.

UNIQUE NATURAL RESOURCES IMPACT RATINGS

🟥 High

🟨 Low

= No Unique Natural Resources

FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

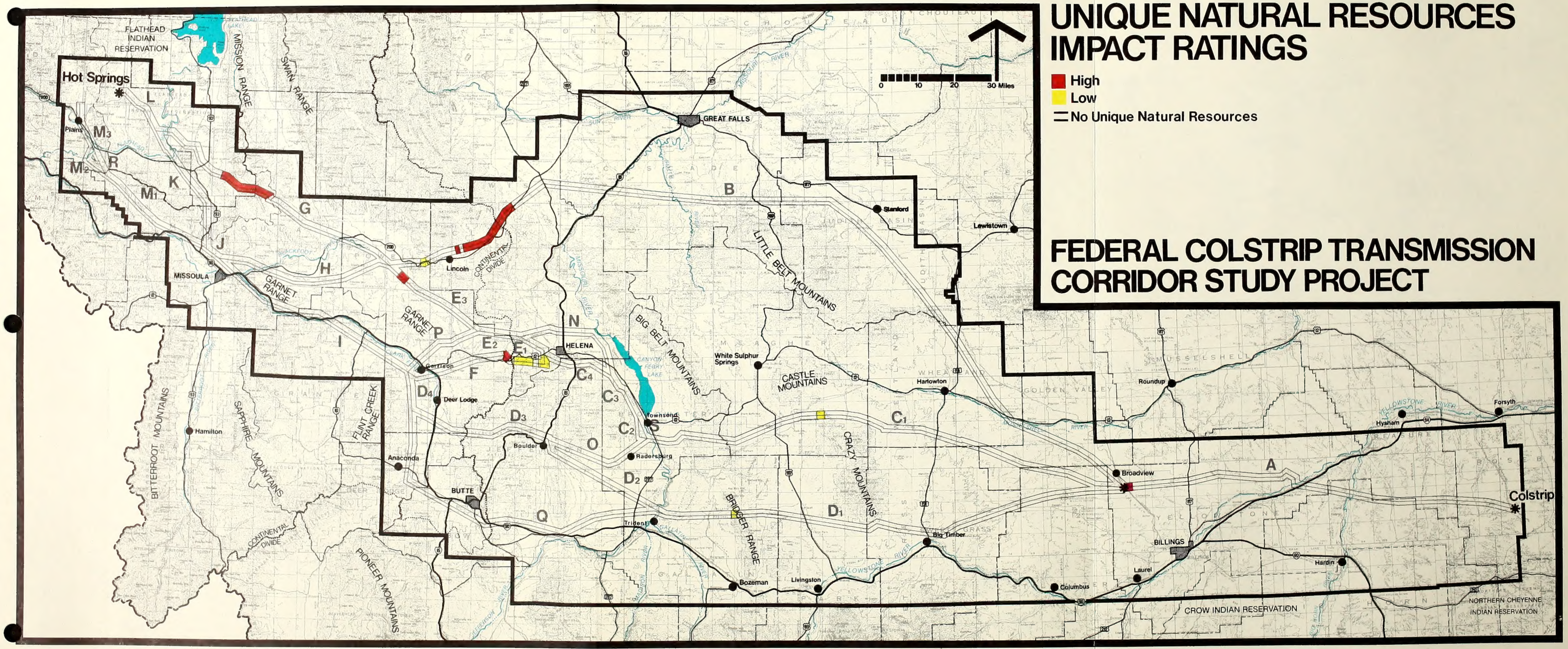


Figure VII-10

Corridor segment G (Applicant's proposed corridor and the Great Falls alternative) passes through the Placid-Blanchard Planning Unit on the Lolo National Forest. The management objectives for the National Forest land crossed are to maintain or improve the deer and elk habitat, and to maintain vigorous stands of timber and optimize the timber growing potential. This proposed 2-mile wide corridor would be adjacent to an existing transmission line across this planning unit. However, in centerline location, the two rights-of-way would be separated by as much as a mile to avoid adding to the visual effects associated with the existing line. Generally, the proposed corridor is compatible with the management objectives for the National Forest Land, but the complex ownership pattern would require close coordination with the numerous landowners.

Corridor segment M (Siegel Pass alternative) traverses the Ninemile-Mill Planning Unit on the Lolo National Forest. The general management guidance for the planning unit provides that any permitted land use must be designed and installed in a way that meets the management objectives for the management unit where the impact would occur. The management objectives and guidance for each of the units crossed emphasizes the esthetic or recreation attributes of the unit. The introduction of two parallel 500-kV transmission lines would be in conflict with these management objectives.

SOCIAL AND ECONOMIC

DISCUSSION

Effects on Demography Housing and Social Services

The potential social and economic impacts from the construction of this transmission corridor would be similar for whichever corridor is selected. Most of the expected impacts would be from line construction activities and would last only for the duration of those activities. Some long-term impacts which might occur include effects on property values and the property tax base.

Transmission line construction proceeds in a defined sequence (see discussion of Construction Sequence in BPA 1977b). In order, these stages are reconnaissance and surveying, land appraisal and acquisition, right-of-way clearing and road system improvement, and finally line construction. Line construction involves putting in the tower foundation, tower assembly and erection, line stringing and tensioning, and finally clean up. Crew size for each task varies from 3 or 4 to 25 or 30 people (see Chapter II for further discussion).

Work crews are generally hired locally if available. However, often the skills needed for the specialized construction activities are not available locally, and a percentage of the work force must be brought in from elsewhere. This influx of workers could have social and economic impacts on communities located near the transmission line route, since the workers require housing, food, entertainment, and a variety of trade and service items. In addition, a few workers might bring their families with them, especially during the summer months.

Since the construction sequence proceeds in well-defined and discrete stages, all the workers on a job are not in the same community at the same time. A crew for one stage of work would stay in an area while working on a line segment and then move to another community to work on the next segment.

In addition to making temporary jobs available to local residents, the contractor would attempt to use local sources for equipment and facilities, especially for grading and clearing, and for supplies of concrete and rock. This potential income from increased employment, trade, and services should have a beneficial economic impact on most communities.

Construction schedules for the lines have not yet been prepared, although the Westinghouse report (1973, Section 3.7.1.1) and the Montana DNRC report (1974, Volume 4, Section 6.2.3) estimate line construction would take 5 years. The lines would be built in segments of approximately 110 miles in length, and each segment would require 6 to 18 months of construction time. Construction activity is generally limited to the dry summer months. Thus, impacts on the local communities from the presence of the construction workers are seasonal. In communities whose economies are dependent on a summer tourist trade, the construction activities might aggravate an existing seasonal influx of people.

Montana DNRC has projected a "worst-case" population influx per 110-mile segment ranging from 225 to 675 people for a crew size of 100 to 300 people (DNRC/DEIS 1974: Section 6.2.3.1). This projection was based on several assumptions: that the entire construction work force is composed of in-migrants and that 50 percent of the construction workers would be accompanied by 2.5 dependents. A "best-case" projection puts the population influx in the range of 113 to 338 per 100- to 300-person crew for each 110-mile segment. The best-case projection is based on assumptions that 50 percent of the construction crew is hired locally and that 50 percent of the in-migrants would be accompanied by 2.5 dependents.

In-migrant construction workers would stay in motels and/or hotels or bring their own campers and trailers and use trailer facilities. The impact of these workers on the facilities of the communities depends largely on the size of the community. Billings, Great Falls, Missoula, Butte, Helena, and Bozeman could easily absorb the influx of construction workers. The same number of workers coming into a much smaller community would have a much larger impact. However, it is expected that the in-migrant construction workers would choose to stay at dispersed communities along the route, thus reducing the impact on any one community.

It is not known how many people would be hired to work on this line, how many people hired would be local residents, or where in-migrant employees would choose to stay. Thus, the impacts from the construction activity cannot be quantified nor specified for a particular community. Following is a list of impacts which could possibly occur as a result of construction activities. Community officials should use this as a checklist to examine the adequacy of community facilities. It must be emphasized these are potential impacts, and it is entirely possible a community may experience none of them.

Demand for housing could result in:

- inadequate motel/hotel accommodations and competition between tourists and construction workers for those accommodations;

- inadequate spaces for mobile homes and insufficient utility hookups (for electricity, water, and sewer), and competition between tourists and construction workers for existing space; and

- inadequate accommodations in private domiciles.

Demand for goods and services could have the following impacts:

- insufficient electricity, sewer, water, and garbage facilities;

- lack of parking facilities for vehicles in communities;

- inadequate services for private vehicles, (e.g., gasoline, repairs);

- unsatisfied demand for necessary special clothing (e.g., safety shoes); and

- inadequate food supply (i.e., supermarkets located miles from housing and excessive demand on small, local markets).

Health and social services might be adversely impacted by the temporarily increased population. Possible impacts include:

- inadequate medical facilities and an insufficient number of physicians and other health care professionals;

- insufficient mental health services (e.g., therapists, counselors, crises interventionists, etc.);

- insufficient infant day-care facilities; and

- inadequate intellectual and spiritual facilities (e.g., libraries and churches).

A major in-migration of workers could affect the school programs and facilities. A worst-case estimate had 50 percent of the transmission construction workers accompanied by 2.5 dependents (DNRC/DEIS 1974: 211). Such a high influx of workers could result in an inadequacy of staff and facilities for preschool, kindergarten, elementary, and secondary levels. Existing systems to transport children to school could be inadequate to handle the increased student population.

An increased demand for the telephone and cable television services could overburden the system and cause competition between residents and construction workers for those services.

Local recreation facilities (e.g., supervised summer playgrounds) could be inadequate to handle the increased demand from construction workers and their families. State and Federal recreation sites might not be able to accommodate the increased demand from construction workers and their families when added to the existing demand from residents and tourists, especially on weekends and holidays.

Law enforcement and protection might prove inadequate for the increased population. Existing resources might be inadequate to provide security for personal property. Civil and criminal legal processes might be incapable of accommodating any increase in load. Existing firefighting systems and equipment could be inadequate. Existing plans to cope with physical crises (e.g., evacuation plans in case of forest fires) could be disrupted.

A more intangible, but nonetheless real, possible impact is the impact on "community cohesion" both in the short-term during the presence of the in-migrant construction workers and in the long run. A community's cohesion or sense of community is directly related to the lifestyle chosen by the residents of that community. A person's lifestyle reflects an attempt to complement his/her perceptions of well-being for self and family (e.g., living in a rural community free of smog, congestion, etc.) and can temper a person's efforts to establish a community norm incompatible with dynamics such as growth and change, both in the short- and long-term. The presence of in-migrant construction workers and their families is a more pervasive influence on a community's lifestyle and cohesion, but the long-range presence of transmission facilities could also disrupt community cohesiveness.

Economic Impacts

Agricultural Crop Losses

Transmission line construction would cause a loss in agricultural crop production on the lands traversed by any of the corridors. A small amount of land would be permanently lost from production. Production on a larger amount of land would be temporarily lost for the year of actual construction. Production would be reduced on that land for a subsequent 2- to 3-year period of recovery.

Temporary loss of production would be greatest on the Butte-Anaconda, Trident-Boulder and Siegel Pass alternative routes. Over the life of the project, the greatest permanent production loss would occur on the Great Falls, Butte-Anaconda, and Trident-Boulder alternatives. (See Table VII-22). The smallest temporary losses in production would occur on the Townsend-Boulder and Helena (Avon Valley) alternatives. The smallest permanent reduction in the value of annual crop production, approximately $30,000 would result on the Townsend-Boulder and two Helena alternatives. Two other corridors with relatively low permanent reductions in the value of annual crop production would be the Siegel Pass and the Applicant's proposed alternatives.

Range Productivity Losses

The grazing capacity of the lands traversed by the various corridors would be reduced by construction of the transmission line. From 870 to over 1,000 animal unit months (AUMs) would be lost during the construction and vegetative recovery period; approximately 300 AUMs would be lost per year for the life of the project because of maintained access roads. These grazing losses would represent lost revenues ranging from $5,200 to $6,300 each year of the construction and recovery period (approximately 5 years) and $1,800 to $2,200 annually (constant 1977 prices) for each year thereafter (see Table VII-23).

Table VII-22 - ESTIMATED MAXIMUM VALUE OF LOST AGRICULTURAL PRODUCTION (1975 Commodity Prices)

CORRIDORS	LENGTH IN MILES	CROP LANDS CROSSED (miles)		MAXIMUM ACREAGE INFLUENCED (miles x 40)		ESTIMATED MAXIMUM CROP VALUE LOST DURING CONSTRUCTION*			ESTIMATED MAXIMUM CROP VALUE LOST DURING RECOVERY PERIOD**			ESTIMATED MAXIMUM CROP VALUE LOST ANNUALLY FOR LIFE OF PROJECT***		
		IRR.	NON-IRR.	IRR.	NON-IRR.	IRR.	NON-IRR.	TOTAL	IRR.	NON-IRR.	TOTAL	IRR.	NON-IRR.	TOTAL
APPLICANT'S PROPOSED	431.3	20	83	800	3320	$109,600- 220,000	$395,000	$504,600- 615,000	$36,500- 73,300	$131,900	$168,400- 205,200	$ 700- 1400	$31,600	32,300- 33,000
SIEGEL PASS	446.3	35	81	1400	3240	192,001- 385,000	385,500	577,500- 770,500	64,000- 128,600	128,800	192,800- 257,400	1200- 2500	30,800	32,000- 33,300
GREAT FALLS	447.6	13	102	520	4080	71,200- 143,000	485,500	556,700- 628,500	23,700- 47,600	161,700	185,400- 209,300	500- 900	38,900	39,400- 39,800
HELENA (MACDONALD PASS)	445.3	21	76	840	3040	115,000- 230,000	361,700	476,700- 592,700	38,300- 76,900	120,400	158,700- 197,300	800- 1500	29,000	29,800- 30,500
HELENA (AVON VALLEY)	445.7	19	78	760	3120	104,100- 208,000	371,300	475,400- 580,700	34,700- 69,600	123,600	158,300- 193,200	700- 1400	29,600	30,300- 31,000
TOWNSEND-BOULDER	443.2	20	76	800	3040	110,000- 220,000	361,700	471,700- 581,700	36,600- 73,300	120,400	157,000- 193,700	700- 1500	29,100	29,800- 30,600
TRIDENT-BOULDER	445.4	25	97	1000	3880	137,000- 274,000	461,700	598,700- 736,700	45,600- 91,600	153,700	199,300- 245,300	900- 1800	37,000	37,900- 38,800
BUTTE-ANACONDA	461.2	26	97	1040	3880	142,500- 285,000	461,700	604,200- 747,700	47,500- 95,200	153,700	201,200- 248,900	900- 1900	37,000	37,900- 38,900

* Assuming one crop year for entire width of right-of-way.

** Assuming partial yield reduction for entire width of right-of-way for three-year period.

*** Land occupied by structures.

Table VII-23 - RANGE PRODUCTIVITY LOSSES

CORRIDORS	LOST AUMs		LOST GRAZING[1/] REVENUES	
	TEMPORARY	PERMANENT	TEMPORARY	PERMANENT
APPLICANT'S PROPOSED	877	304	$5,200	$1,800
SIEGEL PASS	869	282	5,500	1,800
GREAT FALLS	916	307	5,600	1,900
HELENA (MACDONALD PASS)	934	336	5,700	2,040
HELENA (AVON VALLEY)	936	326	5,800	2,000
TOWNSEND-BOULDER	930	296	5,600	1,800
TRIDENT-BOULDER	946	332	5,800	2,050
BUTTE-ANACONDA	1,009	356	6,300	2,220

[1/] - Based on the following 1977 Federal and 1976 State and private AUM costs: $1.60 - U.S. Forest Service; $1.51 - Bureau of Land Management; $3.50 - Indian reservation (Based on an average, supplied by Dave Pennington, BIA); $2.00 State of Montana (Montana State Lands Department); $7.40 - Private (Montana State Lands Department); $1.51 U.S. Fish & Wildlife Service.

The Butte-Anaconda and Trident-Boulder alternative corridors would result in the greatest loss in revenue. The lowest loss in grazing revenues would occur on the Siegel Pass alternative, the Trident-Boulder alternative, and the Applicant's proposed corridor. However, the difference between the amounts lost on the Butte-Anaconda route (the most affected) and on the Siegel Pass alternative (the least affected) is small enough that the loss in grazing revenues should not be a major consideration in route selection.

Commercial Forest Production Losses

High voltage transmission line construction affects forest production more than production of other vegetative crops. Whereas grazing and agriculture can still occur in the cleared right-of-way, commercial forest production activity is limited to growing Christmas trees. Land is removed from use for forest production by construction of a transmission line for the life of the line.

A factor which complicates calculation of the annual production loss (1976 dollars) of transmission line construction is that timber production is not an annual crop. The timber production from a 60- to 100-year growing cycle must be broken down into an annual figure, and an annual timber value must be assigned to that figure. The process is further complicated by the differing productivity of the lands crossed by these corridors and by the differing management techniques used by the various private landowners and public agencies.

The following annual figures for lost timber production value by corridor were developed from information supplied by an economist and a forester from the U.S. Forest Service (Lovegrove 1977). Although the figures represent a rough approximation of value lost, they are a guide to comparing the corridors and to giving an idea of the order of magnitude involved:

Corridor	Annual Value of Lost Commercial Timber Production (1976 Values)
Applicant's Proposed	$ 84,000
Siegel Pass	103,000
Great Falls	88,000
Helena (MacDonald Pass)	38,000
Helena (Avon Valley)	52,000
Townsend-Boulder	62,000
Trident-Boulder	50,000
Butte-Anaconda	33,000

Timber production would be least impacted by the Butte-Anaconda and Helena (MacDonald Pass) alternatives. It would be most impacted by the Siegel Pass alternative and to a somewhat lesser extent by the Great Falls alternative and the Applicant's proposed corridor.

Other Losses

The losses discussed in the three preceding sections on agriculture, range, and commercial forest production might be reflected in reduced employment opportunities. This loss would not, however, be significant compared to total job opportunities in the study area or in relation to other activities in the study area which also reduce production. Any loss of this type would be for the life of the project for forestry production and for the duration of the construction period for agriculture and range production.

Another potential impact which cannot be quantified is the effect on the tourist trade of the construction activity and of the long-term presence of the line. This impact is related to the visual impact and the impact on recreation. It could, however, have an adverse effect on the area's income from tourist trade.

Taxes

Increased tax revenue would be collected as a result of transmission line construction. The Montana DNRC estimated that Federal income tax revenue could amount to $6.5 million, Social Security payments would account for $2.5 million, and state income tax would take $1.95 million (DNRC/DEIS 1974).

Another large, positive impact of the transmission lines would be the increased property tax revenue paid on the lines. The Montana DNRC estimates an annual property tax revenue on the lines of $6.6 million (DNRC/DEIS 1974: 233). Calculation of the tax yield is complicated because the utility's property is evaluated as a single unit and the taxable value is prorated among the various counties in which the lines would be located. Evaluation of the value of the property of the utility involves three factors: (1) the current price of the company stock, (2) current earnings of the company, and (3) actual cost of plant equipment the company owns.

The BPA-Build alternative would affect property tax revenues differently than the Applicant's proposal and the other alternatives, as discussed in the "BPA-Build" section of this chapter.

Land Value

Another long-term impact from transmission line construction is the restriction on the use of the land crossed. Restrictions on land use affects the value of the property. The property owner would be compensated for this loss in value by the constructing utility either by the outright purchase of the property or by payment for the easement, but there would still be loss to the area's economy of productive agriculture or forest lands, or of developable urban area.

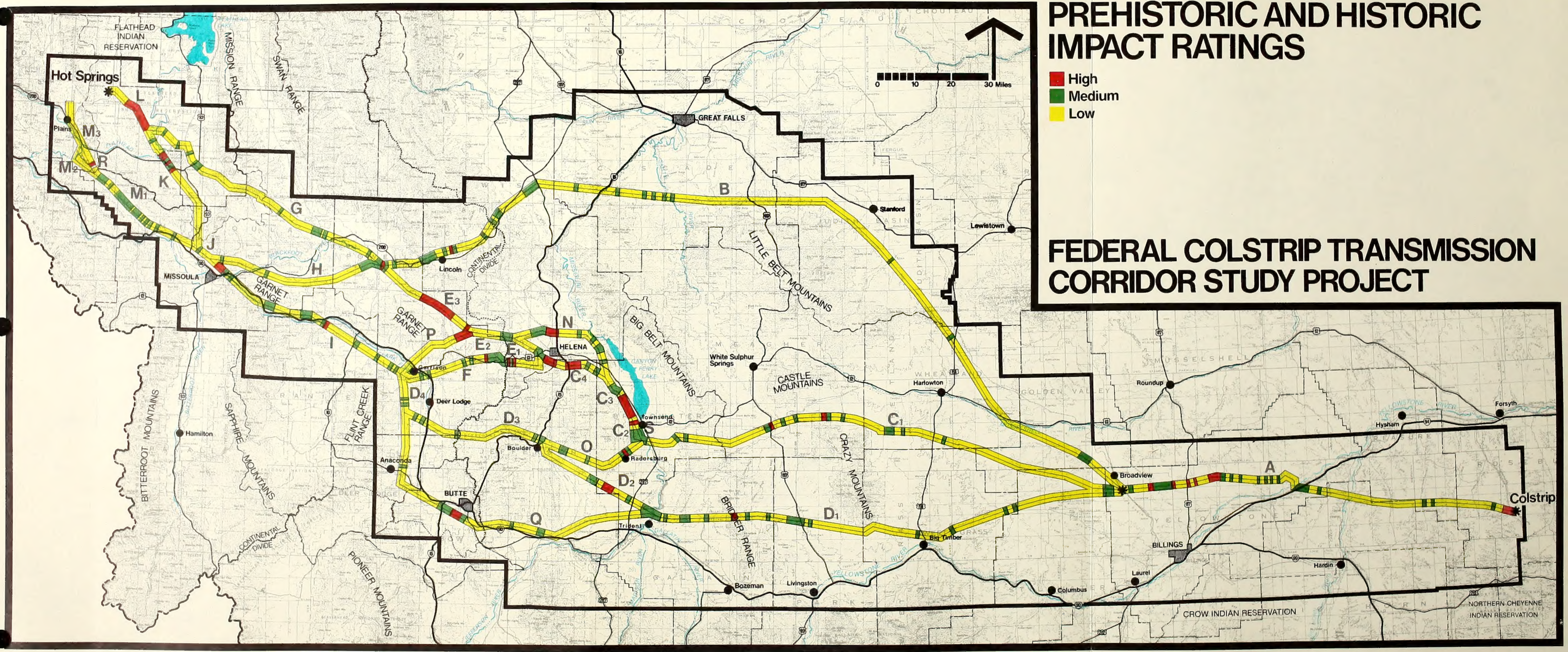
CORRIDOR COMPARISONS

Because many of the social and economic impacts from transmission line construction activities cannot be quantified or even specified, no meaningful comparison can be made to highlight any differences in impacts among corridors.

PREHISTORIC AND HISTORIC

The known prehistoric sites reflect limited cultural resource inventories. In most areas there are many undiscovered sites. Both undiscovered and discovered sites could be safeguarded from the impacts brought about by the construction of the transmission line, associated roads, and rights-of-way, as long as correct mitigation measures are pursued. Similar measures should protect historic resources.

One of the greatest threats to prehistoric and historic resources is the increased accessibility given vandals by the construction of new roads or the repair of old roads. This is especially true for historic and prehistoric resources that should be preserved as a part of the visual landscape. Figure VII-11, the "Prehistoric and Historic Impact Rating map," was used for analysis purposes in this study.



PREHISTORIC AND HISTORIC IMPACT RATINGS

🟥 High
🟩 Medium
🟨 Low

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Figure VII-11

DISCUSSION

Conceptual Basis for the Visual Impact Analysis

Figure VII-12 graphically displays the conceptual model on which this visual analysis is based. Simply stated, transmission lines are more visible in some landscapes than in others. Some landscapes are valued more than others, value being determined by the quality of the land and the visual contact people have with the area. The greater the value placed on the landscape, the less acceptable visible transmission lines are and the greater their visual impact.

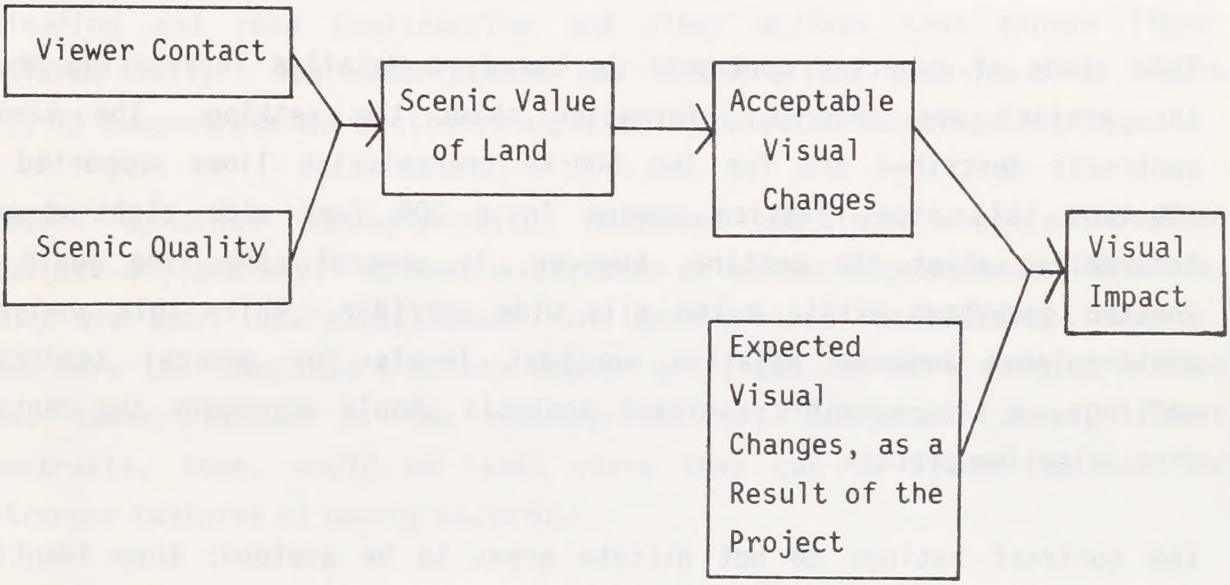

Viewer Contact
Scenic Quality
Scenic Value of Land
Acceptable Visual Changes
Expected Visual Changes, as a Result of the Project
Visual Impact

Figure VII-12 - CONCEPTUAL MODEL FOR VISUAL ANALYSIS

Contrast ratings measure how perceptible the proposed project would be in different landscapes.

Management classes, which are based on landscape quality and viewer sensitivity, group together landscapes of similar scenic value and define acceptable levels of project visibility. When acceptable levels of project visibility, as defined by management classes, are compared with the expected levels of project visibility, as predicted by the contrast ratings, potential visual impacts are identified.

Road building and other grading operations would introduce another form of contrast, that of exposed subsoils against surface soil colors. These contrasts would be most pronounced in steep areas where subsoil colors are markedly lighter than topsoil colors. Steep areas are more sensitive than gently sloping or flat areas because they require more cutting and filling, are more likely to have erosion and regeneration problems, and are more likely to be visible from a distance.

Appendix A-4 contains a discussion of how visual contrasts were quantified for this project. Table A-5-1 shows high, medium, and low contrasts, by link, that would be created by the transmission lines.

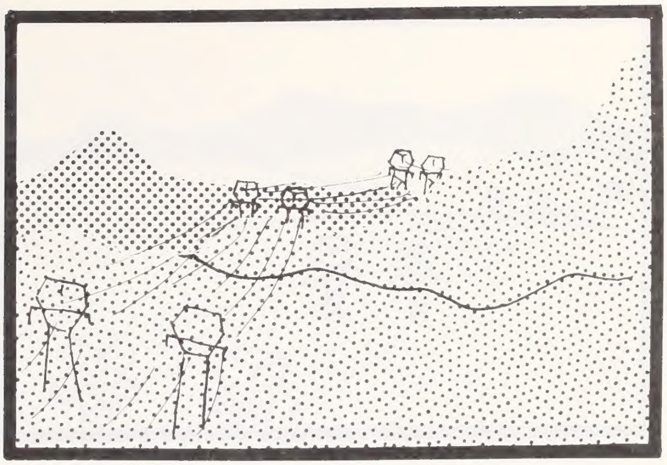
CORRIDOR COMPARISONS

Figure VII-14, the Visual Resources Impact map, displays high, medium, and low visual impacts. Comparisons among the potential corridors over their entire lengths are presented in Table VII-24. For each corridor, total visual impact scores and the percentage each differs from the score for the Applicant's proposed corridor are shown. The right-most column omits segment A, which is common to all corridors, in order to clarify impact differences on the remaining portions. Data item distinctions and the miles of high, moderate and low visual impact crossed by each corridor are also given.

These comparisons suggest that, from a visual resources standpoint, the Trident-Boulder alternatives is the "lease visual impact" corridor, having a 12% lower impact rating than the Applicant's proposed corridor. The Great Falls, Townsend-Boulder and Helena (Avon Valley) alternatives all are rated 9% lower than the Applicant's proposed corridor. The Helena (MacDonald Pass) and Butte-Anaconda alternatives are rated 8% and 7% lower, respectively, for potential visual impact than the Applicant's proposed corridor. Only the Siegel Pass alternative is rated higher for visual impact than the Applicant's proposed corridor. For impact comparisons between the key links in all of these corridors, see the "Visual Resources" discussion in Chapter V and Appendices A-4 and A-5.

Figure VII-13 (A-C)

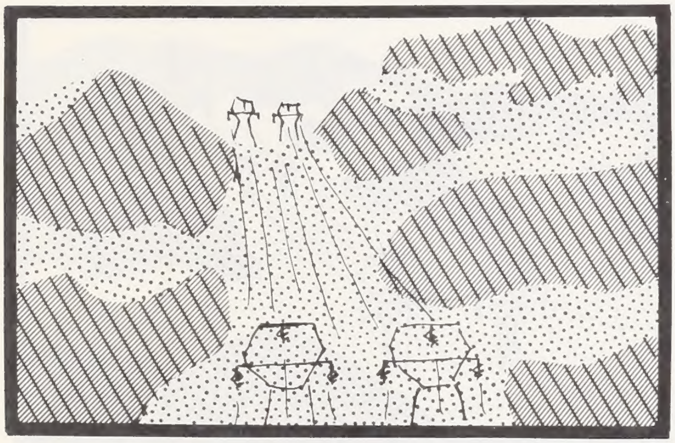
VISUAL CONTRASTS IN SELECTED LANDSCAPE SETTINGS

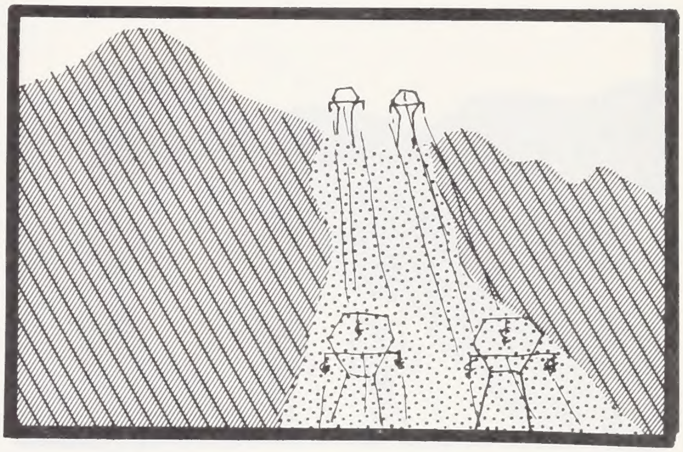


Sources of Visual Contrast:
The descriptions and illustrations presented here demonstrate, in a few selected settings, visual contrasts that towers and right-of-ways would create.

A. **Mountains and Grass/Shrubs**

Towers are often silhouetted against the sky and highly visible. Not affecting vegetation, right-of-ways do not contrast with the landscape.



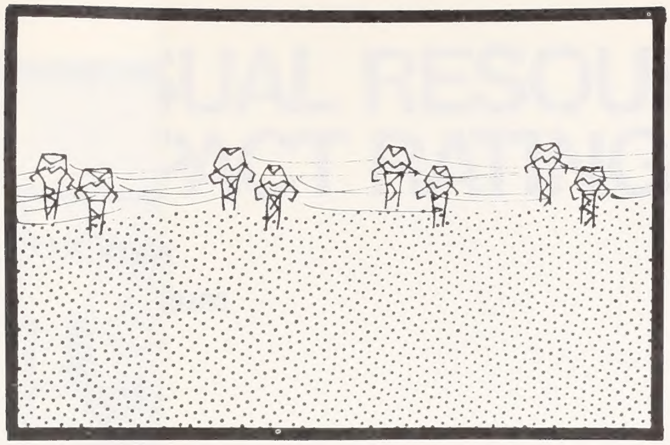


B. **Mountains and Open Forests**

Right-of-way contrasts in this zone are low because of the obscuring effect of scattered natural clearings. Often skylined, the towers create higher than average visibility.

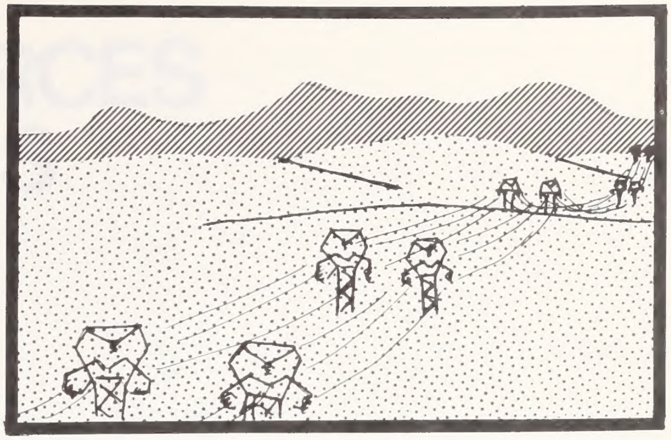
C. **Mountains and Dense Forests**

This setting has the highest corridor contrasts. In addition to the very visible swath cut through the forest, a highly visible notch is often created on the skyline. Towers are seen either against cleared right-of-ways or silhouetted against the sky.



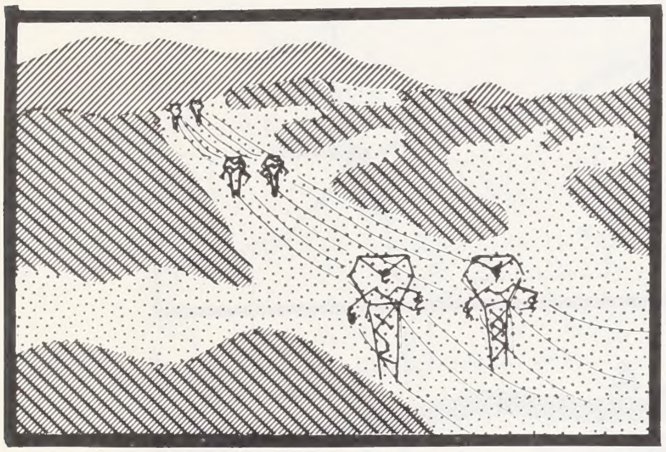
D. **Flat Plains and Grass/Shrubs**

Towers, silhouetted against a light sky, create the most important contrast in these landscapes. Because they do not interrupt vegetation, right-of-ways cannot be distinguished.



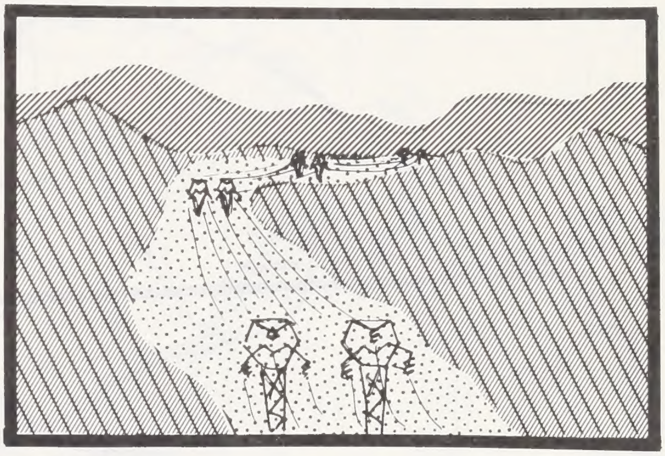
E. **Intermountain Basins and Grass/Shrubs**

Towers are less visible here than in other zones. Towers are often viewed against the surrounding foothills and mountains and rough textured shrubs obscure tower outlines. Corridors cannot be distinguished.



F. **Intermountain Basins and Open Forests**

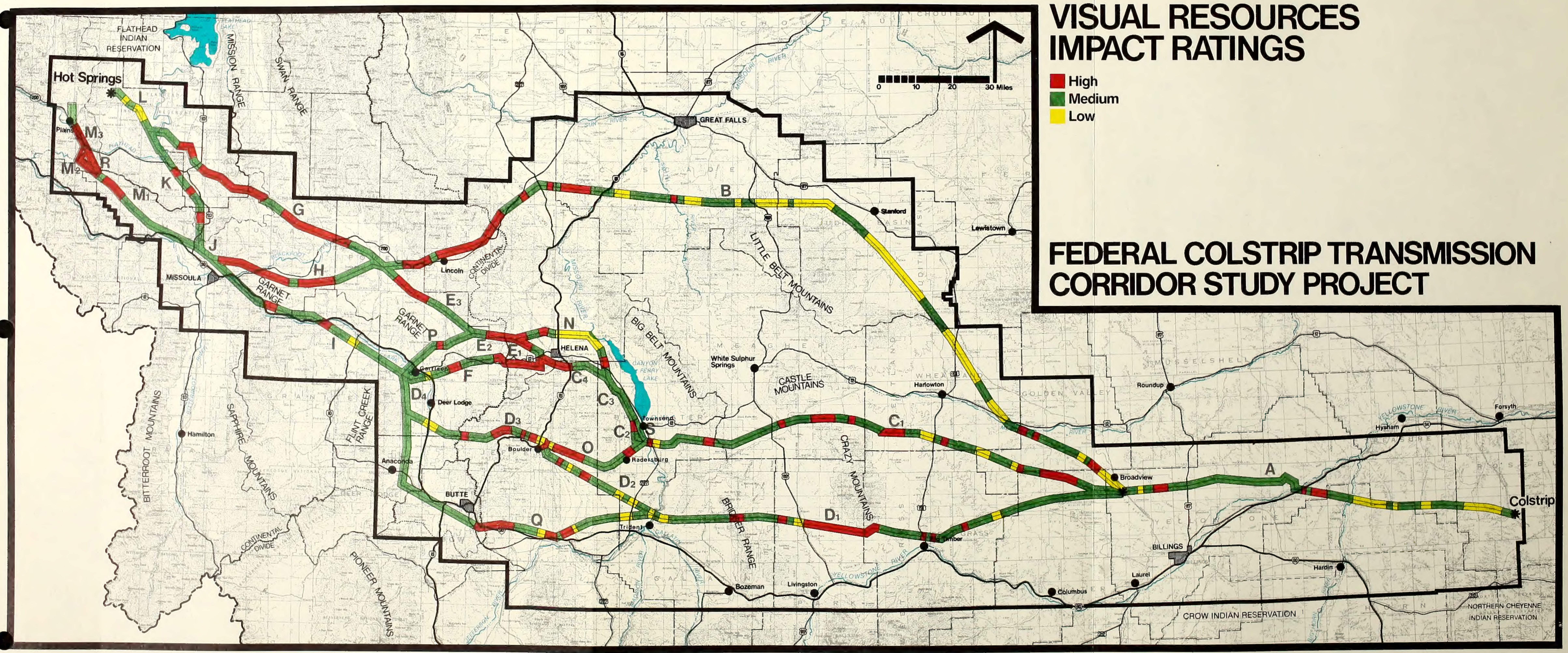
Transmission lines contrast less with this setting than with most. Natural openings in the forests obscure right-of-way outlines and absorb towers quite effectively.



G. **Intermountain Basins and Open Forests**

Right-of-way clearings will be highly visible especially when views are parallel to the corridor. Corridors will contrast obviously with the dark colored forest canopy, a condition that will be aggravated when the clearings are covered with snow.

Figure VII-13 continued (D-G)



VISUAL RESOURCES IMPACT RATINGS

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Figure VII-14

Table VII-24 - VISUAL RESOURCE CORRIDOR COMPARISONS (STEP 3)

CORRIDORS	LENGTH (in miles)	MANAGEMENT CLASSES (miles)				CONTRAST (miles)			VISUAL IMPACTS (miles)			VISUAL IMPACT SCORE 1/	% DIFFERENCE FROM APPLICANT'S
		PRESERVATION	RETENTION	PARTIAL RETENTION	MAXIMUM MODIFICATION	HIGH	MODERATE	LOW	HIGH	MODERATE	LOW		
APPLICANT'S PROPOSED	431.3	2.8	148.9	273.3	6.3	58.3	276.2	96.8	121.7	264.4	45.3	3183	0
SIEGEL PASS	446.3	12.9	144.0	289.4	0	68.2	305.6	72.5	134.4	273.0	38.9	3368	+6
GREAT FALLS	447.6	0	155.5	285.8	6.3	44.8	229.1	173.7	107.2	222.2	118.3	2975	-7
HELENA (MACDONALD PASS)	445.3	9.5	93.9	333.6	8.3	28.8	331.7	84.8	78.1	318.8	48.5	2995	-6
HELENA (AVON VALLEY)	445.7	2.8	92.9	343.7	6.3	35.3	327.0	83.4	74.9	324.6	46.3	2985	-6
TOWNSEND-BOULDER	443.2	2.8	105.6	328.5	6.3	25.8	331.1	86.3	75.9	320.9	46.5	2976	-7
TRIDENT-BOULDER	445.4	0	87.8	351.3	6.3	25.9	339.5	80.0	64.7	329.9	51.9	2911	-9
BUTTE-ANACONDA	461.2	0	84.7	370.2	6.3	17.5	363.2	80.5	64.9	351.3	45.1	3021	-5

1/ Not adjusted for effects of paralleling existing transmission lines.

BPA-BUILD ALTERNATIVE

Building the two 500-kV circuits in the western portion of the study area on a stacked, double-circuit line with BPA specifications as compared to building two single-circuit parallel lines with the Applicant's specifications, would alter certain impacts on the environment. Corridor impact scores, as derived from the methodology employed in this report, would not necessarily be different because mileage measurements were one basis for the scores. The greater the distance of sensitive areas crossed by the line, the greater the expected impact. The change in line design would not alter the line length. However, if certain resources are sensitive to change as a result of the narrower right-of-way, different size and type of tower, or the reduced number of towers per mile, some changes in potential environmental impact may occur.

Of the thirteen resource determinants used to evaluate environmental impacts, it was felt that the impact on only three would significantly change due to building according to BPA specifications on a stacked double-circuit tower. These are "Agricultural Land," "Commerical Forest Land," and "Visual Resources", as discussed below.

Impacts on other determinants may be slightly altered due to less ground disturbance from fewer towers and narrower right-of-way, but these differences would not be expected to be significant. For example, under the "Rangeland" determinant there might be less land removed from use during the construction phase, and vegetative recovery may be less of a problem due to this decreased disturbance. However, the long-term effects of acres removed from production or AUMs lost each year would not differ significantly from those projected in the analysis.

Property tax revenues realized on the power line would be diminished under the BPA-build alternative. BPA powerlines are Federal property and would not be subject to state and local taxes as would lines constructed by the Applicant.

For "Agricultural Lands", three differences in specifications between the parallel and stacked line versions would be associated with potentially different impacts. First, with a narrower right-of-way for the stacked version (125 ft) than for that of the parallel version (300 ft), only 42% as much acreage would be removed from production during the construction phase. Estimated acreages for the two corridor links involved are presented in Table VII-25. For these estimates, it was assumed that the entire right-of-way would be utilized during construction and only one year's crop would be eliminated. Reduced crop production during a 2-3 year recovery period on the right-of-way likewise would be only 42% as serious on the narrower right-of-way.

Table VII-25 - ACRES REMOVED FROM AGRICULTURAL PRODUCTION DURING A ONE-YEAR CONSTRUCTION PERIOD - PARALLEL VS STACKED LINES

LINK	LINE VERSION	LENGTH (miles)	TOTAL AGRICULTURAL LAND Acres/mi [3/]	TOTAL AGRICULTURAL LAND Total Acres
OD_3D_4IJKL	Parallel[1/]	36	36.36	1,309
	Stacked[2/]	36	15.15	545
PIJKL	Parallel	32	36.36	1,164
	Stacked	32	15.15	485

[1/] - Two 500-kV parallel lines with Applicant's design specifications
[2/] - Two 500-kV stacked lines with BPA design specifications
[3/] - Acres/mi = width of ROW (ft) x 5,280 ft/mi - 43,560 sq ft/acre

The second difference involves the number of towers required. Placement of only 4.5 towers per mile of line on the double circuit version as compared to 8.2 per mile on the parallel lines would reduce the total area required for tower occupancy for the life of the project. If the towers were of the same basal configuration, the difference in number of towers alone would mean that only 45% as much land would be occupied using the stacked version.

The specification for self-supporting structures on the stacked line as compared to guyed structures on the parallel line provides the third difference in potential impacts on agricultural lands. Numbers of acres permanently removed from production for each tower type are given in Table VII-26. Each self-supporting stacked structure would occupy about

900 square feet (26 feet, plus 2 feet on each side for equipment clearance). Thus, each mile of line with 4.5 towers per mile would require 4050 square feet, or 0.09 acres, for tower bases. This is 35% of the 0.26 acres per mile required for parallel guyed structures (see the "Agriculture" section of this chapter). These figures represent the comparative land areas involved in crossing irrigated land.

Table VII-26 - ACRES REMOVED FROM AGRICULTURAL AND COMMERCIAL FOREST PRODUCTION FOR THE LIFE OF THE PROJECT - PARALLEL VS. STACKED LINES

LINK	LINE VERSION	AGRICULTURE				R-O-W AND ROADS	COMMERCIAL FOREST	
		Irrigated		Dryland				
		ACRES/MILE	TOTAL ACRES	ACRES/MILE	TOTAL ACRES	ACRES/MILE	TOTAL ACRES	TIMBER VOLUME (MCF)
OD_3D_4IJKL	P[1]	.26	3.6	3.2	70.4	43.4	2348	5328
	S[2]	.09	1.3	.09	2.0	22.2	1201	2676
PIJKL	P[1]	.26	3.4	3.2	60.8	43.4	1286	2945
	S[2]	.09	1.2	.09	1.7	22.2	657	1503

1/ - Two 500-kV parallel lines with Applicant's design specifications

2/ - Two 500-kV stacked lines with BPA design specifications

Crossing dryland agricultural fields with stacked, self-supporting towers would involve the same acre figures as for irrigated land. However, because land beneath guy lines cannot be farmed with large equipment, the acreage removed from production on the two parallel guyed lines would be 3.2 acres per mile. Thus, the land removed from dryland agricultural production would be only 2.8% as much for the stacked line as for the parallel version. Estimated acreages for each line specification for the two corridor links involved are given in Table VII-25.

Other potential impacts on agricultural activities resulting from the presence of guying cables would also be eliminated if self-supporting structures were utilized. Movement of large field equipment would be more direct, aerial spraying operations would be safer, and other maneuvers would be simplified if guy lines were not present on agricultural lands.

Because less right-of-way clearing would be required, impacts on "Commercial Forest Lands" would be lower if the stacked version were built. Access road requirements are assumed to be the same in both instances. Total area cleared for both right-of-way and roads on link PIJKS would be approximately 657 acres for the stacked line version as compared to 1,286 acres on the parallel version (see Table VII-26). This would be a reduction of nearly 50% for the former. Likewise, nearly 50% less timber volume would be removed (1503 MCF as compared to 2,945 MCF) should a stacked line rather than double parallel lines be built on this link.

Estimated acres and volumes of timber removed for link OD_3D_4IJKL are 1,201 acres vs. 2,348 acres, and 2,676 MCF vs. 5,238 MCF for the stacked and parallel versions, respectively. Thus, comparatively, impacts along this link would also be only half as severe if the stacked line were built (see Table VII-26).

Visual impacts of transmission facilities built to BPA's specifications for a stacked configuration would differ from the visual impacts of two parallel lines built to the Applicant's specifications. Scenic quality and visual sensitivity portions of the visual analysis would remain the same regardless of the type of line; contrast ratings, however, would change due to different corridor widths, and tower heights and mass. The estimated distances over which corridors and towers would remain highly visible for the two sets of specifications are presented in Table VII-27.

Table VII-27 - PREDICTED TOWER AND CORRIDOR VISIBILITY (Miles)[1/]

LANDSCAPE	TOWERS (Height) 123 ft	TOWERS (Height) 176 ft	CORRIDORS (Width) 120 ft	CORRIDORS (Width) 300 ft
Flat Plains	1.0	1.5	n/a	n/a
Intermountain Basins/Grass	.9	1.3	n/a	n/a
Intermountain Basins/Open Forest	1.0	1.4	1.0	2.4
Intermountain Basins/Dense Forest	.9	1.4	1.5	3.7
Foothills/Grass	1.2	1.7	n/a	n/a
Foothills/Open Forest	1.3	1.8	1.0	2.5
Foothills/Dense Forest	1.2	1.8	1.5	3.7
Mountains/Grass	1.2	1.8	n/a	n/a
Mountains/Open Forest	1.2	1.8	1.1	2.8
Mountains/Dense Forest	n/a	n/a	1.7	4.5

1/ - Adapted from Jones and Jones (1976)

These values indicate that in forested areas the 300-foot corridor would be visible about 2.5 times farther than the 120-foot corridor; the reduced contrast of the smaller corridor is so significant that in some forested areas tower heights would actually create more contrast than the corridor clearing. Contrasts produced by the narrower corridor would increase as the terrain steepens, but since the same relationship holds for the wider corridor, relative comparisons remain about equal for all types of forest landscapes. Corridor contrasts for agricultural lands and rangelands remain negligible.

Values in Table VII-27 indicate approximately how far 123-foot and 176-foot towers remain highly visible. In general, the taller towers remain highly visible about 1.5 times farther than the shorter ones. Table VII-27, however, compares towers that are more dissimilar than those proposed by BPA and the Applicant: the example compares towers with a 53 foot difference in height, whereas the BPA's and Applicant's towers differ by only 35 feet. Therefore, differences in tower visibility would be less than those suggested in this example. Also, the greater height and visibility of the BPA tower may be somewhat offset by the smaller number of towers. According to Johnson, el. al. (1970:8), "In almost all situations, single towers are preferable to pairs of towers and should be selected . . . wherever there are alternatives."

Use of stacked-line corridor widths, tower sizes, and tower numbers would: (1) substantially reduce visual impacts in forested areas; and (2) slightly increase visual impacts in non-forested areas. Table VII-28 shows the visual impact changes that would result from building the stacked line alternative; 21% and 27% of links PIJKL and OD_3D_4IJKL, respectively, would have substantially reduced impacts, whereas 79% and 73%, respectively, of these links would have slightly increased impacts. Visual impact reductions in forested areas would be more significant than the slightly increased impacts in non-forested areas; thus, visual impacts of the stacked version would be considerably less.

Table VII-28 - VISUAL IMPACT FOR BPA'S VERSUS APPLICANT'S LINE SPECIFICATIONS

	SUBSTANTIALLY SMALLER VISUAL IMPACTS		SLIGHTLY GREATER VISUAL IMPACTS	
LINKS	Miles	% Total Link	Miles	% Total Link
OD_3D_4IJKL	53.4	27	144.20	73
PIJKL	29.6	21	111.7	79

As mentioned in Chapter II under the BPA-Build Alternative, the full scope of BPA's vegetation management program may include the use of herbicides. Potential impacts which could result from the application of herbicides are persistence of the chemical in the soil, vegetation, wildlife, and water; damage both to desirable vegetation within the right-of-way and to nontarget vegetation off the right-of-way; alteration of wildlife habitat; exposure to humans and livestock; and visual impacts in scenic or sensitive areas. A detailed discussion of BPA's right-of-way management program is provided in Appendix B of BPA's Role EIS (BPA 1977b:B-VI-1 to 13 and VII-74 to 78).

SUBSTATION IMPACTS

The potential substation development for this project involves only a very small part of the project's total land area. All of the potential substation study areas lie at intersections between corridor segments (see Figure VI-1). Consequently, in discussing the transmission corridor impacts over a two-mile wide corridor, potential substation impacts have been addressed. Herbicides may be used by BPA to control plant growth at their substations and communication and control facilities. Additional information on potential substation impacts is provided in Appendix B of BPA's Role EIS (BPA 1977b:Chapter VII).

COMMUNICATION AND CONTROL FACILITY IMPACTS

GENERAL

The Applicant has a preferred and at least one alternative means of communications between Colstrip and Hot Springs for each transmission corridor being considered. The Applicant's site selection parameters appear consistent with those used by environmentally concerned communications engineers throughout the power industry. These parameters include:

1. general routing along the transmission line corridor for VHF mobile radio coverage of the line right-of-way;
2. the fewest possible number of sites to achieve the required communications;
3. utilizing existing sites, facilities, structures and other development where possible; and
4. combining site specific locations and construction parameters to mitigate impacts during site development and later operations and maintenance.

The communications and control facilities portion of a major transmission project is usually less than 5 percent of the total project cost, with the communications facilities being in the neighborhood of 2 percent of the total project cost. The remainder of the facilities are installed in substations, generating plants and control centers which result in minimal impact. Even though this analysis concentrates on the communications impacts, they are minor relative to the impact of the overall project.

ANALYSIS WEIGHTING AND TREATMENT

This analysis is a comparison of impacts among communications alternatives. Thirteen principal impact categories have been identified and assigned weighting values from 1 to 13. This range of impacts appears to be close to linear from the least to the highest impact. The weighting rationale by impact category is as follows:

1. Road Improvement (weighting factor 1) - Road improvement is considered to be the least impact as work would be done to an existing road with an existing impact and defined centerline location. This factor is applied to each mile of road to be improved;

2. Fuel Tanks (weighting factor 2) - This weighting factor considers the construction impact, tank visibility and the need for annual fuel delivery. This factor is applied to each new fuel tank required;

3. New Antennas (weighting factor 3) - Adding new antennas would require stronger towers. Antennas are also visible above grade. Because a tower is a prerequisite for an antenna, the antenna impact would be a small addition to the tower impact. This factor is applied to each new parabolic antenna required;

4. Antennas of 10 ft. or larger (weighting factor 4) - The most significant factor of a large antenna is that it's wind loading requires a more substantial tower. Larger antennas also have a higher visible exposure. This factor is applied to each new parabolic antenna of 10 or more feet in diameter;

5. New Heliports (weighting factor 5) - A heliport requires a 200 foot radius free from obstruction and relatively level to allow helicopter maneuverability and landing. The main impacts from heliport construction are tree clearing and leveling. This factor is applied to each new heliport to be developed;

6. New Road Development (weighting factor 6) - This factor considers a new road along a new centerline. Since roads would only be required for active stations, the road requirement is further weighted below by virtue of the heavy impact assigned to new station development. This factor is applied to each mile of new road required;

7. Power Development (weighting factor 7) - This factor considers a new station service powerline along a new centerline which would possibly have a common route with the access road but would usually follow a route more direct than a grade dependent road. The buried powerline approach to power development further mitigates impact. This factor is applied to each mile of new powerline required;

8. Passive Repeaters (weighting factor 8) - This factor considers a passive repeater as requiring minimum site development with no access road or power required. Where technically applicable, a passive repeater is of significantly less impact than it's alternative which would be an active station with road, power, building, tower, etc. This factor is applied to each new passive repeater required;

9. New Towers (weighting factor 9) - This factor considers a new tower in light of the excavation required with disposition of excavated material plus the fact that it is a structure protruding above grade and visible at a distance from the station. This factor is applied to each new tower required;

10. New Towers of 70 ft. or higher (weighting factor 10) - This factor considers the fact that a taller tower: would require

greater footing excavation; would have a more massive structure covering more site space; and would be more visible at a distance. This factor is applied to each new required tower of 70 feet or higher;

11. New Buildings (weighting factor 11) - This factor considers a building, which is the largest structure investment, as a significant impact. A building requires the most structure maintenance in terms of upkeep, maintenance access, etc. This factor is applied to each new building required;

12. Active Station (weighting factor 12) - This factor considers the overall impact of an active station and further weights the individual impacts of tower, fuel tank, building, road, and power plus impacts for access during fuel delivery and maintenance. This factor essentially credits systems utilizing the fewest number of active stations to achieve the required communications. This factor is applied to each active station required; and

13. New Active Stations (weighting factor 13) - This factor is the heaviest used in this analysis and further weights the active stations for the added impacts of developing new stations including survey construction with testing, and energizations. This factor is applied to each new active station that is required.

ANALYSIS RESULTS

The "Communications Impact Summary Matrix" (Table VII-29) shows the impact scores, based on the above weighting factors, for all of the communications alternatives. The impact scores range from a low of 550 for alternate IV-A to a high of 1085.5 for alternate II-B. Changing weighting factors may slightly affect results, but the above result is predictable considering that the lowest impact alternate IV-A is in the low end of the scale for every impact category. The mid-range contains eight alternatives (I-A, V-A, IV-B, V-B, I-B, III-B, II-A, III-C, in order of increasing impacts). There are four high impact alternatives: II-A, I-C, IV-C, II-B, in order of increasing impacts. Table VII-30 shows the relationship between communication alternatives and the individual site numbers from Figures II-3 and II-2.

Table VII-30 - COMMUNICATIONS ALTERNATIVES: SPECIFIC SITES

CORRIDOR	COMMUNICATIONS ALTERNATIVES 1/	SITE NUMBERS 2/
APPLICANT'S PROPOSED	Route A	1-10, 11A, B or C, 12-16, 18-20
	B	1-10, 11A, B or C, 12, 13, 15-18
	C	1-8, 10, 12, 16-18, 22-24, 34A, 35-37, 41
SIEGEL PASS	Route B_1	1-10, 11A, B or C, 12, 13, 15, 16, 25
	C_1	1-8, 10, 12, 15, 16, 22-25, 34A, B, 35, 40-41
GREAT FALLS	Route D	1-7, 15-18, 28-30, 32, 33, 34A, 35, 38-40
	A_1	1-10, 12-16, 18-20, 33, 38, 39
	B_3	1-10, 12, 13, 15-18, 33, 38, 39
HELENA (MACDONALD PASS)	Route A	1-10, 12-16, 18-20
HELENA (AVON VALLEY)	B_2	1-10, 12, 13, 15-18, 26
	C_2	1-8, 10, 12, 13, 15-18, 22-24, 26, 42
BUTTE-ANACONDA	Route A_1	1-10, 12-16, 18-20, 31
TOWNSEND-BOULDER TRIDENT-BOULDER	B	1-10, 12, 13, 15-18, 31

1/ - In order of preference.
2/ - Refer to Communication Station Index, Table II-1.

		TRANSMISSION ALTERNATIVE													
		APPLICANT'S PROPOSED CORRIDOR			PROPOSED CORR. W/SIEGEL PASS ALTERNATIVE		GREAT FALLS ALTERNATIVE			HELENA ALTERNATIVE McDONALD PASS OR AVON VALLEY			ANACONDA–BUTTE, TOWNSEND–BOULDER & TRIDENT–BOULDER ALTS.		
IMPACT CATEGORY / COMMUNI. ALTS.	IMPACT WEIGHTING ***	I A	I B	I C	II A	II B	III A	III B	III C	IV A	IV B	IV C	V A	V B	
ROAD IMPROVEMENT (Mi.)	1	2.5 * 2.5**	2.5 2.5	2 2	2.5 2.5	2 2	1 1	3.5 3.5	3.5 3.5	2.5 2.5	2.5 2.5	2 2	2.5 2.5	2.5 2.5	
FUEL TANKS	2	3 6	6 12	9 18	6 12	9 18	6 12	5 10	7 14	4 8	6 12	6 12	4 8	6 12	
NEW ANTENNAS	3	18 54	22 66	26 78	22 66	26 78	26 78	23 69	27 81	18 54	20 60	20 60	19 57	22 66	
LARGE ANTENNAS (10' AND OVER)	4	12 48	17 68	16 64	16 64	16 64	21 84	14 56	19 76	12 48	15 60	15 60	13 52	17 68	
NEW HELIPORTS	5	2 10	2 10	5 25	2 10	3 15	7 35	4 20	4 20	2 10	2 10	1 5	2 10	2 10	
ROAD DEVELOPMENT (Mi.)	6	0 0	0 0	0.5 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	
POWER DEVELOPMENT (Mi.)	7	3.5 24.5	3.5 24.5	17.5 122.5	3.5 24.5	17.5 122.5	15 105	3.5 24.5	3.5 24.5	3.5 24.5	3.5 24.5	2.5 17.5	3.5 24.5	3.5 24.5	
PASSIVE REPEATERS	8	0 0	1 8	4 32	0 0	4 32	2 16	0 0	1 8	0 0	1 8	3 24	0 0	1 8	
NEW TOWERS	9	9 81	11 99	13 117	11 99	13 117	14 126	11 99	13 117	9 81	11 99	12 108	9 81	11 99	
TALL TOWERS (70' AND OVER)	10	2 20	3 30	4 40	3 30	4 40	4 40	2 20	3 30	2 20	3 30	3 30	2 20	3 30	
NEW BUILDINGS	11	7 77	9 99	12 132	9 99	12 132	13 143	8 88	10 110	7 77	9 99	10 110	7 77	9 99	
TOTAL ACTIVE STATIONS	12	19 228	16 192	18 216	16 192	18 216	19 228	21 252	18 216	19 228	16 192	17 204	19 228	16 192	
NEW ACTIVE STATIONS	13	2 26	2 26	3 39	2 26	2 26	0 0	2 26	2 26	2 26	2 26	2 26	2 26	2 26	
COMMUNICATIONS ALTERNATIVE–IMPACT SCORE		577	637	888.5	625	862.5	868	668	726	579	623	658.5	586	637	
RANKING: 1 = LOWEST IMPACT		1	6	12	5	10	11	8	9	2	4	7	3	6	

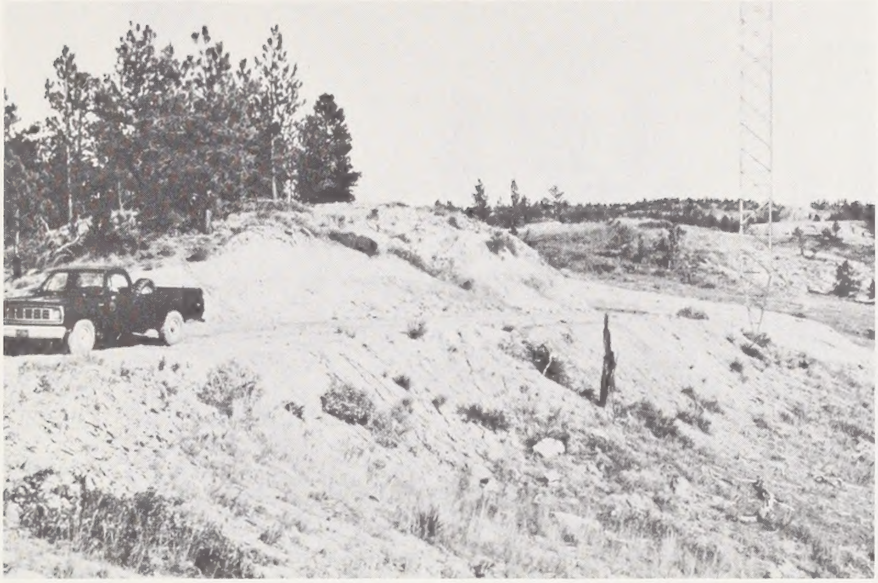
COMMUNICATIONS IMPACT SUMMARY MATRIX

* Number in small box quantifies impact for the particular communications alternative. These numbers are derived from the Communications Site Data Matrix-Table II-1 and quantify the impact category for all sites in the alternative. Road and power are in units of miles.

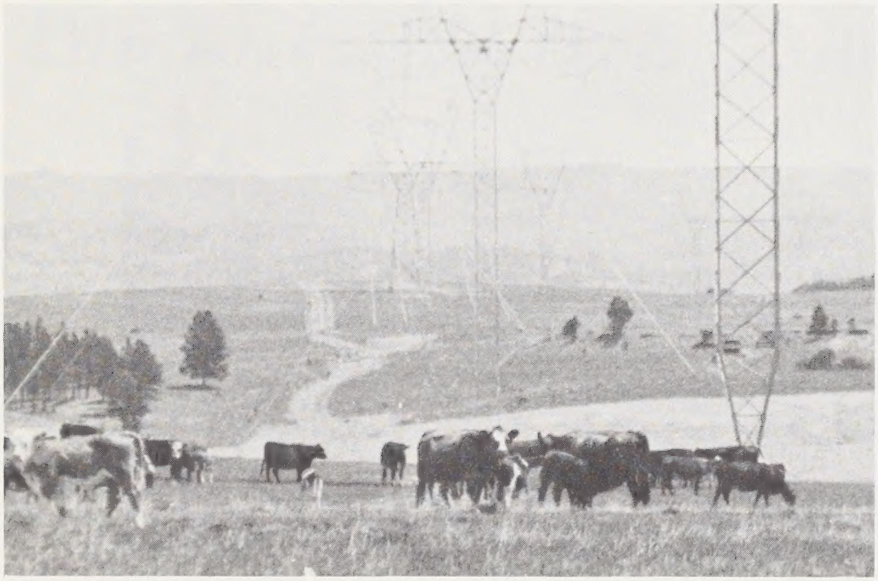
** Number in large box is result of multiplying the impact quantity by the impact weighting.

*** 1 = lowest weight and 13 = highest weight.

Table VII-29

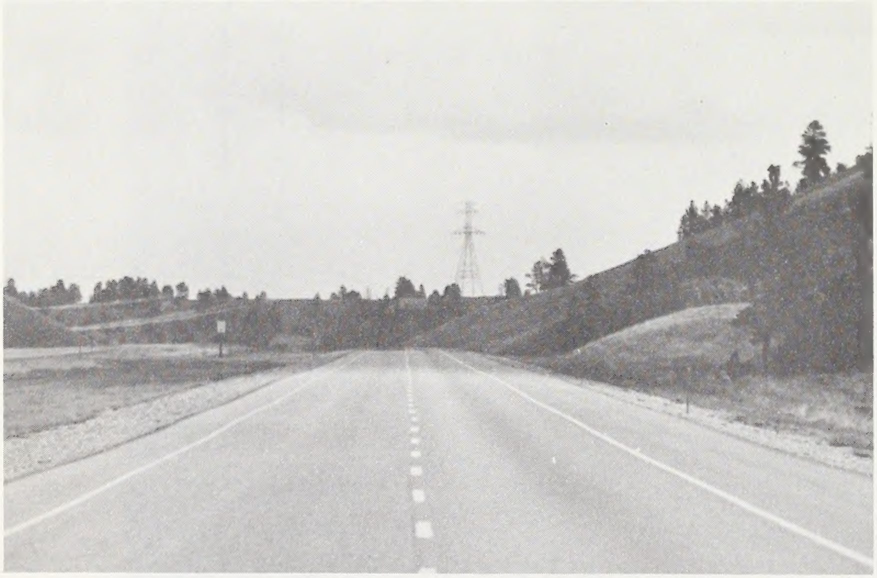


Access road on Colstrip to Broadview 230 kV line (Montana DNRC photo taken Sept. 1977).



Grazing under energized Colstrip to Broadview 230 kV line (C. T. Main, Inc., photo).

Visual contrast reduced at a highway crossing by leaving trees (BPA photo).



Visual contrast increased by silhouetting tower from key observor points (Colstrip to Broadview line at its crossing of I-94 east of Pompeys Pillar - BLM photo).

MITIGATING MEASURES FOR APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

MITIGATING MEASURES FOR APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

A number of planning, design and construction practices can be used to prevent and minimize adverse impacts. Vegetative management practices used in right-of-way maintenance can also minimize adverse impacts.

The Montana Board of Natural Resources and Conservation has approved a set of construction guidelines for this project that would have to be followed by the Applicant during construction and post-construction activities (Appendix E). The following mitigating measures are recommended by the Study Team to Federal land managers. They should be considered wherever Federal lands would be crossed by the transmission lines. These mitigating measures are also recommended for all land ownerships under the BPA-Build Alternative.

TRANSMISSION LINE AND SUBSTATION DEVELOPMENT

Once a corridor has been agreed upon, the centerline studies could relate these measures to specific areas along the route. Since many of the mitigating measures apply to several resource categories, they have been arranged into three broad groups - Natural, Social and Visual.

NATURAL

1. Local, state and Federal laws regulate vehicle exhaust emissions. Construction equipment should be maintained and operated to insure compliance. In critical areas, exhaust emissions could be reduced by restricting the number of and/or the operating time of equipment.

2. Herbicides should not be used during construction or maintenance of this line (WESD/AEA 1973:3-81; see Appendix E) except as required by local weed control districts or at BPA controlled support facilities.

3. Filter strips (areas with continuous vegetative cover and undisturbed soil) should be left along all identifiable stream channels.

Filter strips should be a minimum of 100 feet wide, and a minimum of 200 feet wide in the M_8 and P_3 mapping units (Figure III-6) and in all mapping units where slope gradients exceed 60 percent. Adjustments to the above recommended widths can be made as warranted by local topography, soil stability and stream value (USDA Forest Service 1971; Kitchings, et al. 1974).

4. Cross-drains, such as broad-based dips, culverts, waterbars, outsloped road sections, open-top culverts, etc., should be installed on all permanent and temporary roads. Cross-drain spacing would depend upon road grade, parent material or bedrock type, topographic position, slope aspect, and slope gradient (Packer 1967). Many guides have been developed for determining cross-drain spacing, and different guides may be in use in various parts of the study area. Cross-drain spacing should therefore be agreed upon with the local land manager on an on-site basis. Where local experience and expertise either conflict or are not available, the information provided in Table VIII-1 is recommended.

5. Unless otherwise agreed upon by the appropriate land manager, construction should cease during spring snowmelt and other unusually wet periods of the year. Maximum soil compaction and destruction of soil granulation occurs when the soil is wet (Baver, et al. 1972:107) This is especially important in Corridor Link A (Figure VI-1) and in the following Land Suitability Units (Figure III-6): M_8, P_2, P_3, P_6, and A_2. These units are particularly sensitive to moisture for the following reasons:

   a. A_2 - flood hazard;

   b. M_8, P_3 - severe erosion and sediment risk hazards; and

   c. P_2, P_3, P_6, Link A - the bearing capacity of the soils in these areas is greatly reduced when they become wet, since they become excessively muddy, and severe damage to the soil may result.

Table VIII-1 - CROSS-DRAIN SPACINGS REQUIRED [1/]

ROAD GRADE	CROSS-DRAIN SPACING (feet) Hard Sediment	Basalt	Granite	Glacial Silt	Andesite	Loess
2%	167	154	137	135	195	95
4%	152	139	122	120	90	80
6%	144	131	114	112	82	72
8%	137	124	107	105	75	65
10%	128	115	98	96	66	57
12%	119	106	89	87	57	48
14%	108	95	78	76	46	37

Source: Packer

[1/] - Table shows cross-drain spacings required to prevent rill or gully erosion deeper than one inch on secondary logging roads built in the upper topographic position of north facing slopes having a gradient of 80 percent. On middle topographic position, reduce spacings 18 feet; lower topographic position, reduce spacings 36 feet. On south aspects, reduce spacings 15 feet. For each 10-percent decrease in slope steepness below 80 percent, reduce spacings 5 feet.

6. Because of the severe erosion and sediment risk hazards in Land Suitability Units M_8 and P_3 (Figure III-6), road grades in these units should be held to less than 8 percent. Unless otherwise agreed upon by the appropriate land manager, all roads, staging areas and concrete batch plant sites in these units should be surfaced with crushed rock or other comparable erosion preventing

material, and roads should be supplied with culverts at all natural drainage channels to avoid concentrating water from several watersheds. Sediment control structures should be installed where deemed necessary by the appropriate land manager.

7. Cut and fill slopes should be seeded in the spring or fall season immediately following construction. Seeding methods, mixtures and appropriate soil amendments should be agreed upon with the land manager.

8. Following primary use, staging areas, concrete batch sites, temporary and intermittent-use road surfaces, and other temporary-use areas should be closed, ripped (or otherwise loosened) and seeded. Seeding mixtures and appropriate soil amendments should be agreed upon with the land manager (MPC 1977:9,10). Disturbed areas should be seeded prior to the lapse of the current growing season.

9. Unless otherwise agreed upon with the local land manager, all seedings on Land Suitability Mapping Units with a moderate or severe erosion hazard rating (see the "Soils" impact section, Chapter VII) should be mulched with two tons of straw per acre or an amount of other mulching material which would provide equal protection (MPC 1977:2).

10. Should rills deeper than 1 inch develop on any disturbed area, erosion control measures should be considered inadequate and should be upgraded or supplemented (Packer 1967).

11. Every effort should be made to avoid road crossings of flowing streams. Where crossing identifiable stream channels cannot be avoided, bridges or culverts should be used. Temporary crossings of perennial streams should be made with temporary bridges rather than culverts (DNRC/DEIS 1974:241; BPA 1977: B-VIII-4; USDA-USDI 1970:19).

12. Bridges or arch culverts should be required where culvert size or gradient would prevent fish passage.

13. Corrugated metal or native timber culverts used in temporary roads should be removed following use. Culverts which are not removed may become blocked or deteriorate and collapse, thus causing the stream to erode a new channel (USDA Forest Service 1971).

14. Culverts should not discharge directly on unprotected fill slopes.

15. Logs should not be yarded through identifiable stream channels. Intermittent streams with resistant channels on flat terrain are an exception (BPA 1972).

16. Trees should not be felled into any perennial stream channel. Should debris become deposited in perennial stream channels, it should be removed immediately. Debris deposited in intermittent channels should be removed before the streams are likely to flow again (Lantz 1971; BPA 1972).

17. Should it become necessary to clean a stream channel, cleaning by hand would be preferable to cleaning by machine to avoid disrupting the stream bottom (Lantz 1971).

18. Topsoil ("A" horizon) should be stockpiled and replaced wherever it would be necessary to excavate or scarify soil in Land Suitability Units F_2, F_5, M_8, P_2, and P_3 (see Figure III-6). These units have a low revegetative potential, and some of them have highly erodible subsoils which are very difficult to revegetate unless topsoil is replaced. The same practice should be carried out where requested by the local land manager (USDA-USDI 1970:19; DNRC/DEIS 1974:241).

19. Topsoil should also be stockpiled and replaced wherever dark colored soil (i.e., Munsell value darker than 3.5 when moist and chroma less than 3.5 when moist) 7 or more inches in thickness would be excavated or scarified.

20. Land Suitability Units M_{18} and, to a lesser degree, M_7, M_{12}, M_{14}, and M_{20} (Figure III-6) are susceptible to mass movements of soil and rock. All tower construction and cut-and-fill road construction in these units should be preceded by detailed geologic investigations. Following these investigations, agreement should be reached with the appropriate land manager whether to proceed with construction as planned, and, if so, what protective measures should be required (i.e., subsurface drainage, pilings, 3:1 cut-and-fill slopes, etc.).

21. Throughout construction, material excavated from slopes with gradients of 60 percent or more should not be cast down slope, but rather end-hauled or otherwise disposed of as agreed upon by the local land manager (USDA Forest Service 1974d:6).

22. Soils on heavily used roads should be watered or otherwise treated during dry periods to reduce dust. This is especially important on corridors which cross Land Suitability Units A_2 and F_1 (Figure III-6) as these units have soils which can become exceptionally dusty (MPC 1977:3).

23. Particular care should be exercised in locating concrete batch plant sites and staging areas. These are high-use areas requiring soils with low hazards of erosion and dust, high bearing strength and good trafficability.

24. Oil and other waste products should not be disposed of by dumping on the ground or into a stream channel (MPC 1977:3).

25. Work areas should never be allowed to go through a winter season without erosion protection measures to adequately handle the subsequent snowmelt period.

26. Maximum use should be made of existing roads in order to minimize new road construction.

27. In no case should waterways be used as roads or skid trails, regardless of how temporary the roads may be.

28. Off-road vehicle travel and equipment use should be prohibited except when authorized in advance by the appropriate land manager.

29. The use of tractors and other motorized land vehicles for pulling sock lines should not be permitted in areas where residual timber stands may be damaged. Also, in areas of steep terrain or unstable soil conditions, helicoptors should be used for tower installation and pulling sock lines.

30. All temporary roads and other clearings in forested areas should be reforested following use. Consideration should be given to creating a vegetational community which is capable of existing without constant maintenance. Competitive and nutritious forage species for wildlife and livestock should be introduced where practical. Those species that establish rapidly and would not be a maintenance problem for either the transmission line or access roads should receive primary consideration. Where erosion is a problem, non-palatable species should be planted to discourage trampling by big game and livestock. The local land management agencies should be consulted for those plants that would meet these requirements for specific areas.

31. Unless otherwise agreed upon by the appropriate land manager, the original contour of the ground should be restored when reclaiming temporary roads, staging areas, batch plant sites, and other temporary use areas (MPC 1977:9). Ruts should be immediately filled or leveled after completion of construction. If left unaltered these ruts on sloping land will act as erosion paths due to accumulation of water during rainfall or snowmelt. Also, plowing or deep tillage of the compacted area as soon as possible will aid its productivity (Baver, et al. 1972:194).

32. Blasting should not be allowed in streams, or near enough to a stream to cause the stream to become contaminated with excavated material (MPC 1977:6).

33. Selective clearing should be used to produce natural appearances along the right-of-way. Minimal clearing would preserve as many trees and other vegetation as possible on the right-of-way and adjacent areas. Any merchantable timber cut should be utilized, unless written approval to do otherwise is obtained from the land manager. Right-of-way clearing should be limited to the cutting of trees which would interfere with conductor stringing or operation of the line over a ten-year period. Visual compatibility should be taken into consideration at all times in right-of-way clearing.

34. Excavated material should not be disposed of in stream flood plains.

35. Transmission facilities should not be located in flood plains. Where flood plains are so wide that they cannot be spanned and transmission towers must be located in them, the towers should be constructed to withstand a flood of 100-year frequency.

36. Brush blades instead of dirt blades should be used on bulldozers in clearing and clean up operations where such use would help preserve the existing cover of grasses and low-growing shrubs and minimize erosion.

37. Full compliance with all applicable state and Federal fire laws and air pollution regulations would be required. Any time burning is in progress the Applicant should have a sufficient number of men on the site to keep the fires under control.

38. All flammable waste material on the powerline and road rights-of-way and in the danger tree zone should be piled and burned or otherwise disposed of as directed by the land manager. Waste material includes tops, branches, unmerchantable and unsalvaged trees, snags, down logs, dislodged stumps, cut brush, and rotton

wood whether: (1) caused by the contractor's operations or (2) existing previously to his operations. Previously existing downed tree material, over eight inches in diameter, which occurs singly or in groups of not over four which can be separated so it does not create a fire hazard need not be burned. Large dislodged stumps and root masses that cannot be burned should be buried.

39. Location and clearing for tower footings, substations, control houses, maintenance buildings, and radio communication facilities should be limited to the minimum service area as agreed upon. Native vegetation should be retained as natural landscaping wherever possible.

40. Successful revegetation of a seeded area would be enhanced if given protection and time to recover. Thus grazing should be deferred for a minimum of three years (USDA Forest Service 1973a).

41. All scrap resulting from the construction of the project such as wire, bundle ties, nails, bolts, and other hardware which is hazardous to domestic or wild animals should be picked up promptly and disposed of properly.

42. Any range improvements such as fences, cattleguards, and gates removed because of construction activities should be replaced or repaired promptly if required by the land manager.

43. Construction crews should leave all gates encountered as they are found (i.e., open or closed) to avoid any livestock distribution problems.

44. Where footings for towers in areas of high human, livestock, or big game concentrations are being excavated, temporary barricades or lighted warning devices should be considered to prevent men or animals from accidentally falling into the hole any time the construction crew is not on the site, especially at night.

45. As none of the threatened or endangered plant species discussed in Chapter III has been found in the study area to date, these species might not present a problem, but if any species on this or any future Federally recognized list is encountered, every effort must be taken to avoid impacting it.

46. Where streams are crossed, precautions must be taken to avoid altering any stream course. Such alterations could effectively destroy the existing riparian vegetation type that many forms of wildlife, as well as livestock, are dependent on during at least part of the year. Stream channels should be crossed at near perpendicular angles where towers can be set back from stream channels.

47. Before establishing a borrow pit, all required permits would have to be obtained.

48. Clearing of survey lines should be limited to that necessary to gain a line of sight. Only hand and small power tools should be allowed. Shrubs should be preserved to the greatest extent possible. Trees should be pruned rather than cut down if this would permit adequate sighting.

49. Trees on or adjacent to the right-of-way that need to be felled should be designated and approved by land managers. Low-growing trees and brush that grow no higher than 20 feet should not be cut except at tower sites.

50. Trees and shrubs should be cut as close to the ground as practical, with a maximum stump height of six inches. Stumps not interfering with construction activities should not be disturbed.

51. Hand clearing might be required by the land manager in certain sensitive areas as determined on a site-by-site basis. Special logging techniques might also be required.

52. Tractors should not be used to fell or bunch trees, snags, brush or slash for burning on slopes over 35 percent in grade.

53. Cutting devices mounted on mobile equipment could be allowed if it can be demonstrated that undue disturbance of the soil and waste of merchantable timber would not occur.

54. A centerline location should be chosen to avoid specific sites of high wildlife impact risk, such as:

    a. Traditional nest sites of species of special interest or concern (e.g., falcons, eagles);
    b. Colonial nesting areas (e.g., great blue heron);
    c. Waterfowl concentration areas; and
    d. Key habitat areas for game species, such as:
        (1) rutting areas, grouse display grounds;
        (2) calving, fawning, or breeding areas;
        (3) winter concentration areas; and
        (4) elk wallows.

    Elk security areas should be avoided in crossing summer and fall ranges. If security areas cannot be avoided by the transmission line, construction and maintenance activities should not occur during seasons of use (see Table VIII-2).

    Restriction of all construction activity within one-half mile of a bald-eagle nest during nesting season should adequately protect the site (USFS 1969). This distance might need to be increased where eagles are unaccustomed to vehicular traffic.

Table VIII-2 - SEASONALLY IMPORTANT WILDLIFE HABITAT

Habitat	Season of Use	Avoidance Required
Calving, fawning, or kidding	May 15 - June 15	No construction (surveying acceptable)
Raptor Nesting or (eagles, osprey, falcons)	Feb. 15 - June 15	No activity within 1 mile line of sight
Waterfowl breeding	Apr. 1 - June 15	No construction, 1/4 mile
Sharptailed grouse dancing grounds	Apr. 1 - June 1	No construction, 1/4 mile
Sage grouse	Mar. 1 - May 15	No construction, 1/4 mile
Spring grizzly habitat	Mar. 1 - June 15	No activity
Bear dens	as occupied	No construction within 1 mile

55. Existing forest clearings or nontimbered areas should be used to minimize right-of-way clearing. Utilization of existing right-of-way clearing would be optimum.

56. Drainages should be crossed where conductor clearance requires only topping of trees or little or no clearing.

57. Any stable, dead, or dying trees, in or near the right-of-way, which do not endanger construction activites or the operation of the line should be left standing.

58. Construction and maintenance crews should be properly trained and supervised to eliminate problems created by careless or incomplete performance of tasks.

59. The centerline should correspond closely with existing fences, trails, roads or other borders on agricultural land. Placing a tower at the end of a field where only two of the four guy lines are in the field would reduce the acreage removed from production.

60. Where feasible, towers should be sited to occupy uncropped areas only. Such wasteland or pasture rather than tilled land should be used if this option exists. If towers must be placed on farmland, the farmer should be consulted before locating towers on the less productive patches in the field. Many agricultural soils of the study area are characterized by large variations in properties within short distances, with frequent gravelly patches, lime ridges, eroded knobs, salt flats, or other factors which prevent high productivity.

61. Where agricultural fields are crossed, the minimum area required to accomplish the construction should be clearly marked and the crew advised to carefully observe these boundaries.

62. Construction activities should be scheduled to conflict the least with cropping and to occur when soil conditions are least susceptible to damage. Periods of high rainfall and wet surface soils should be avoided. Activities should be programmed to require a minimum of time on each parcel of land. Construction during winter months when the soil surface is frozen would perhaps be best for these reasons.

63. Only one roadway or path across a field should be used. One severely compacted path would have less total adverse effect on subsequent production than would a much broader area of moderate to high compaction.

64. Machines and vehicles should be equipped with high-floatation tires or tracks to minimize soil compaction. Crawler type tracks on heavy equipment are especially effective in reducing soil compaction.

65. Areas which have the most surface cover (e.g., a field area with heavy standing stubble or forage crop) rather than fallow ground should be chosen, if possible. Clean-fallowed land is most susceptible to compaction and erosion (Blakely, et al. 1957:290).

66. Placing towers in a "barrier" position to automated irrigation systems should be avoided. Most irrigated fields in the study area are not extremely large and are interspersed with pastures and non-productive land. Most fields could be completely spanned by the normal tower spacing of 800 to 2500 feet (WESD/AEA 1973:3-75).

67. Areas potentially irrigable due to desirable soil characteristics or water source, or those where farmers indicate they plan to install automated irrigation systems, should be managed in a manner similar to those areas where irrigation is already established.

68. Towers that must be located in a central field position should be free-standing. This would reduce the area removed from production around each tower by sixteen fold, and allow a much more direct forward movement of large equipment.

69. On strip-cropped or contour-farmed land, tower placement should be compatible with the width of the equipment used by the farmer. This would allow such desirable conservation farming practices to continue. If the distance between a tower or guy line and the edge of a strip or contour line would be less than the equipment width the crop practice would have to be completely altered, with a potentially drastic impact on the field.

SOCIAL

Although many of the mitigating measures described in the "Natural" section also apply to social concerns, the following list presents additional measures which should be implemented for this project to minimize social impacts.

1. Since most of the comprehensive plans prepared by the city and county planning agencies in the study area do not address the location of high voltage transmission line or utility corridors, line location should be compatible with the general principles of existing plans. In addition, line location planners should consult with local planning entities, including tribal councils, to determine the optimum location.

2. Where a school might be located adjacent to the right-of-way, the tower structures should be fenced or otherwise equipped with anti-climbing devices. Playground equipment and fences should be grounded.

3. Construction traffic, road detours, and related traffic changes should be scheduled to avoid conflict with major spring, summer, and fall holidays, especially "three day" weekend traffic.

4. Where general use of the right-of-way is determined undesirable by the land manager, access should be controlled with fences, gates or other barriers.

5. Problems with radio and television reception caused by any of the transmission facilities would be mitigated on a case-by-case basis. Many corrective actions are available, the most common being relocation and/or replacement of the receiving antenna (Loftness 1977).

6. Shock hazard objects, such as metal roofs, fences and antennas on the transmission right-of-way should be grounded to avoid shocks from electrostatic or electromagnetic phenomena.

7. Mitigation of inductive interference on neighboring wire communication lines would be performed in cooperation with the affected utility. Preventative techniques include addition of choke coils, neutralizing transformers, isolation transformers and other protective devices (Eichin, et al. 1975).

8. Viewsheds of existing intensive public recreation areas, such as state parks, National Register sites, historic sites, campgrounds, resorts and dude ranches should be avoided wherever possible.

9. Viewsheds of wilderness areas, primitive areas, and wilderness candidate study areas should be avoided and the line kept concealed from these areas wherever possible.

10. Both public and private land owners should be reimbursed for loss in the fair market value of existing land and loss of water based recreation operations lost as a result of this project.

11. Construction camps or major work areas should be located where they would not conflict with the public's use of key recreation sites and areas.

12. Where construction activities conflict with existing use patterns, the public should be reasonably warned.

13. Specially managed areas within or adjacent to the right-of-way should be clearly marked on the ground and possibly fenced to keep construction and maintenance men and equipment off the area.

14. Communities within commuting distance of the chosen corridor should be surveyed to determine which have sufficient facilities to accommodate workers and their families. This information should be provided to the in-migrant workers with the encouragement that they all not try to stay in the same community.

15. Mobile home parks or other temporary living facilities with approved electric, water and sewer hook-ups should be provided where needed for construction crews. Such parks should be provided with fire-fighting equipment, dust abatement, playgrounds and other amenities.

16. The problem of inadequate medical facilities could be mitigated by establishing temporary, emergency transportation to existing treatment facilities.

17. Temporary day care centers could be established in conjunction with a service organization or church, if required.

18. School districts should be forewarned of the influx of additional students so that plans could be made to accommodate them.

19. Public officials, utilities and law enforcement agencies should be advised of temporary increases in population and in needs for services.

20. The possible negative effects on "community cohesion" caused by the presence of the in-migrant construction workers and their dependents could be minimized by holding pre-construction meetings and workshops in the affected communities. These workshops should be conducted by trained, experienced social scientists and should facilitate discussion and problem-solving.

21. Following final corridor selection, a comprehensive inventory and evaluation of the cultural resources subject to potential impact as a result of the project would be accomplished in compliance with Executive Order 11593 and the National Historic Preservation Act of 1966. Based on the inventory evaluations and recommendations, impact on cultural resources would be avoided or appropriate mitigation measures would be developed in consultation with the Montana State Historic Preservation Officer and in accordance with procedures for comment by the National Advisory Council on Historic Preservation prescribed by the National Historic Preservation Act of 1966 and 36 CFR 800.

VISUAL

Frequently, the mitigating measures listed in the "Natural" and "Social" sections also mitigate visual impacts. The following list includes additional measures which would minimize impacts on visual resources.

1. A site-specific evaluation of visual contrasts should accompany the centerline selection process to assure minimum visual impact.

2. Transmission facilities should be screened or backdropped by landforms or existing vegetation wherever possible. Where screening or backdrops would be available for several potential centerline locations, the least visually prominent location should be selected. Vegetation between viewers and transmission facilities would reduce or eliminate their visibility. Vegetation behind the towers absorbs the tower outlines.

3. Transmission lines should cross forested hill, ridge, and mountain contours at oblique rather than perpendicular angles.

4. Natural and man-made focal points and visually prominent landscape features should be avoided.

5. Heavily timbered forests, especially those on steep slopes, should be avoided; crossing any other vegetation category would be preferable.

6. Locating transmission facilities near smaller, man-made structures such as farm buildings, silos, windmills, etc., should be avoided. Such size disparities would increase the visual impact of transmission structures.

7. Where towers would not be skylined, they could be painted to reduce contrasts. Usually dark grey or grey-green towers blend well with forested areas (Jones and Jones 1976).

8. Non-specular reflectors (conductors with a dull, non-reflective surfaces) should be used in areas having a high impact potential. After the transmission corridor location is agreed upon and selected by the agencies involved, a detailed centerline study would be made by each agency, on its own land, to finalize the classification of areas of high visual impacts.

9. At crossings of public use roads and recreation waterways in forested areas, long span towers should be used and only tree topping or minimal clearing permitted between the towers and road or waterway. Towers should be located as far from the road or waterway as possible.

10. Where the tower or corridor would be prominently visible, vegetation should be introduced to soften or screen the contrasts.

11. In forested areas, deflection of the cleared corridor would limit length of views.

12. Vegetation clearings in critical areas should be maintained frequently to avoid heavy, long-term cutbacks.

13. To meet recommended visual resource management class requirements, scars, cuts, fills or other aesthetically degraded areas should be restored to make contrasts acceptable, according to the following schedule (USDA Forest Service 1974c):

Management Class	Restoration Time
Retention	During operation or immediately after
Partial Retention	As soon as possible, but within one year
Modification	Within 1 year
Maximum Modification	Within 5 years

14. Trees, shrubs, grass natual features and topsoil not removed should be protected from damage during construction.

15. Where excessive scarring would result from regular construction methods, helicopters and other special means of clearing and constructing lines should be used.

COMMUNICATIONS SITE DEVELOPMENT

The mitigating measures described in the "Transmission Line and Substation Development" section of this chapter should also be considered in the development of communication sites. However, the following list presents additional measures which should be taken into consideration to minimize impacts in establishing communication sites.

1. Radio stations and passive repeaters should be located off the brow of the hill wherever current and future anticipated beam path geometry would allow. This minimizes skyline silhouetting of structures.

2. Sites should be arranged for the orderly compatible addition of future user facilities.

3. Foliage adjacent to a site should not be disturbed so as to retain a screening effect.

4. Only the minimum timber as required for the site and beam paths should be removed. Wide swath beam paths should be avoided wherever possible.

5. Wherever possible in heavy timber, towers taller than the trees should be used to minimize beam clearing. The trees would then provide a screen for both tower and site.

6. Where possible, trees should be topped rather than removed.

7. Native or suitable ground cover and screening plants should be selectively planted as required to stabilize disturbed earth and improve visual appearance.

8. Minimum height towers should be used so the towers would not protude excessively above surrounding timber (tower height is dictated by line-of-sight clearance between sites).

9. Buildings should be single-story and painted to blend with surroundings (i.e., light green in vegetation areas, light grey in rock areas and beige in desert areas).

10. Emergency engines should be adequately muffled. Where safety code permits, the fuel tank should be either buried or recessed (propane fuel tanks must be above grade).

11. Passive repeaters installed in visually sensitive areas should be painted to blend with their surroundings.

12. Passive repeater structures should be kept as low as allowed by radio parameters.

13. New station service power lines to mountain tops should be buried whenever possible.

14. Minimum clearing should be done on station service power line burial easements.

15. Burial and clearing should not be in a straight line but, rather, routed randomly through timber. Ground contours should be restored wherever disrupted so as to limit runoff damage.

16. Wherever possible, existing rights-of-way such as road sides, etc., should be used for station service power lines, within the limits of the line length economics.

17. Station service power line equipment should be sized for future users, to the extent economically feasible.

18. After construction suitable or native plants should be selectively planted to restore ground cover on disturbed areas.

UNAVOIDABLE ADVERSE IMPACTS FROM APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

UNAVOIDABLE ADVERSE IMPACTS FROM APPLICANT'S PROPOSAL AND THE ALTERNATIVE CORRIDORS

Only impacts that cannot be entirely eliminated by mitigating measures are described in this chapter. Although the general unavoidable impacts which would occur no matter which corridor is selected are discussed, the focus is on those sensitive areas which have the greatest potential for impact regardless of mitigation. Figure I-3 presents these sensitive areas for each corridor.

AIR QUALITY

There would be only short-term unavoidable adverse impacts on the air quality. Although potential air pollution sources would be mitigated to avoid excessive discharge of contiminants into the air, smoke, dust, vehicle exhaust and other types of construction related air pollution would be unavoidable.

SOILS

The impacts on soils have been grouped into two broad categories (Chapter VII): (1) the loss of soil through accelerated erosion, and (2) a decrease in the value of the soil as a medium for plant growth due to compaction, obliteration of the soil profile, and loss of soil nutrients. Practices recommended under "Mitigating Measures," Chapter VIII would greatly reduce the magnitude of these impacts, but even with mitigation, impacts on soils could not be completely avoided. For instance, installing cross-drains on roads, leaving filter strips, and revegetating disturbed areas could greatly reduce but not completely eliminate erosional losses. Soil nutrients could be replaced using lime and fertilizer, but there is no economical and practical method to completely mitigate the adverse impacts due to compaction and obliteration of the soil profile.

The areas listed below are particularly sensitive from a soils standpoint. Effective mitigation for these areas would be very expensive;

even with mitigation, erosion, sediment and turbidity impacts might be consequential (see Figure VII-1).

Corridor	Location	Miles Potentially Affected
Applicant's Proposed Siegel Pass Helena (Avon Valley)	near Loweth	2.2
	near Helena	8.0
		10.2 total
Great Falls	no outstanding problems.	
Helena (McDonald Pass)	near Loweth	2.2
	near Helena	18.9
		21.1 total
Townsend-Boulder	near Loweth	2.2
	near Boulder	6.8
	near Blizzard Hill (SE of Deer Lodge)	4.8
		13.8 total
Trident-Boulder	southern tip of Crazy Mountains	1.0
	near Boulder	6.8
	near Blizzard Hill (SE of Deer Lodge)	4.8
		12.6 total
Butte-Anaconda	southern tip of Crazy Mountains	1.0
	SE of Butte	4.6
		5.6 total

SURFACE WATER

The surface water impacts described in Chapter VII of this report include increases in sediment, turbidity, water yield, dissolved solids, and, possibly, water temperature. Even with the application of mitigating measures, all of these impacts except the increases in water temperature would occur.

Practices recommended in Chapter VIII of this report would greatly reduce the magnitude of the increases in sediment and turbidity. Mitigating measures, especially revegetation, would also reduce the amount of increase in water yield. However, even with the use of prescribed mitigating measures there would be some increases in sediment, turbidity, and water yield.

Increases in dissolved solids could not be avoided or significantly reduced through the use of mitigating measures. Nevertheless, this impact would be of small magnitude and it is not expected to be consequential.

Increases in stream temperature would depend upon the extent of tree removal immediately adjacent to the stream. If a shading strip of trees were left along all stream channels, increases in stream temperature would be insignificant and this impact would have been avoided.

The sensitive areas identified under the "Soils" portion of this chapter are also sensitive from a surface water standpoint (see Figure VII-2).

RANGELAND

The estimated acreage of vegetative cover that would be removed during the construction phase and for the life of the project for the various potential corridors analyzed, as displayed in Table VII-5, would be unavoidably lost for livestock and wildlife use. The animal unit months lost during the recovery period (Table VII-7) and those lost each year for the project life (Table VII-6) because of these forage reductions (Table VII-7) would also be unavoidable regardless of mitigation measures. Figure VII-4 presents the sensitive rangeland areas.

During the construction period, livestock grazing patterns would most likely need to be adjusted by moving the stock from pasture to pasture to avoid conflicting with the construction process, but this should not present much of an inconvenience to the livestock operators.

Vegetation along access roads would be unavoidably impacted by vehicular dust. This would occur during construction, and after construction on roads that are not closed to the public.

On those access roads left open for public use, new spur roads would almost certainly be established off the main access roads. This would result in further vegetative removal and reductions in livestock forage.

There is a good chance that plant diseases, increased insect populations and the invasion of unpalatable plant species due to clearing of extensive areas for the corridor and access roads would further reduce livestock forage.

Although no threatened and endangered plant species are known to exist within the proposed or alternative corridors, if any do occur and they are not identified in time, further population reduction of an already endangered species could result.

Construction of new communication sites and substations or upgrading existing facilities would unavoidably remove some vegetation from production, even though the total amount would only be a few acres, as shown in Table VII-5.

Should it become necessary to establish borrow pits to obtain gravel during construction, the loss of small areas of vegetation would be unavoidable.

FOREST LAND

The clearing of trees from the transmission line right-of-way and for roads is unavoidable; clearings would remain for the life of the project. This would reduce the productive capacity of the forest land and eliminate the contribution that the impacted area makes towards the sustained timber yield.

Transmission lines could interfere with and adversely affect timber harvest operations that use high lead or suspended cable systems. This situation could require that a more expensive logging system be used and that more roads be constructed.

Air quality would be affected by smoke from slash burning. This impact would be short-term, and scheduling the burning for periods of good smoke dispersal would lessen the impact.

Figure VII-5 presents the sensitive commercial forest land areas.

FISH AND WILDLIFE

Appropriate restrictions on construction activity would nearly eliminate impacts associated with displacement of wildlife from seasonally important habitat (if roading and clearing do not themselves represent adverse impacts on that habitat). Some displacement of wildlife by construction activity could not be avoided, but would usually be temporary and not significant. The occasional destruction of small mammals or ground nesting birds would be inevitable.

Avoidance is the only completely effective mitigation measure where road or right-of-way clearing would represent a compromise of shelter and/or security values of a habitat. Other mitigation measures would not eliminate impacts, but might reduce the scale of the impacts. Reduction in scale or success of mitigation would be roughly proportional to (1) the amount of forest cover left, and (2) the extent to which existing access is utilized or how effectively additional access is closed.

Without detailed centerline survey, analysis, and comparison, differences in the effectiveness of mitigation between corridors cannot be established. Many of the mitigating measures for wildlife are very site-specific, and centerline displacement could substantially change the specific impact and the effectiveness of mitigation. It may be assumed that opportunities for effective mitigation of most wildlife impacts are proportionately distributed among the corridors and that differences in wildlife impact ratings following mitigation would be proportionately similar to the impacts assessed before mitigation. The following comparison of corridors highlights differences in impact scores and the few unavoidable differences in potential wildlife impacts (see Figure VII-6).

Applicant's Proposed Corridor

The Applicant's proposed corridor involves 48 miles of high potential wildlife impact areas, primarily big game winter ranges in the Blackfoot and Clearwater drainages (segment G). These winter ranges receive heavy snowfall (100-200 inches; USDA Soil Conservation Service 1975a) and loss of cover may be a significant adverse impact. The Montana Department of Fish and Game has a considerable investment in time and money in the Blackfoot-Clearwater Wildlife Management Area (crossed by seven miles of the Applicant's proposed corridor), which would be compromised if the winter ranges were adversely impacted. The Applicant's proposal confronts 15 miles of proposed critical grizzly bear habitat and a possible grizzly movement corridor along the Jocko Divide (Servheen 1977). This corridor also crosses subapline habitat types between Placid Lake and the Jocko-Placid Divide. The Applicant's proposed corridor (Broadview to Hot Springs) received a total wildlife impact score of 974 and a per mile impact rating of 3.04.

Great Falls Alternative

The Great Falls alternative is 16 miles longer than the Applicant's proposed corridor and crosses 33 more miles of high potential wildlife impact areas, primarily big game range and proposed grizzly bear critical habitat along segment B west of Rogers Pass. These winter ranges also receive heavy snowfall (200+ inches; USDA Soil Conservation Service 1975a). The Great Falls alternative (Broadview to Hot Springs) received a total wildlife impact score of 1288, and an impact rating per mile of 3.83.

Helena (MacDonald Pass) Alternative

The MacDonald Pass alternative is 14 miles longer than the Applicant's proposal, but it confronts 13 fewer miles of high potential wildlife impacts. The MacDonald Pass alternative and the Applicant's proposal are the same from Colstrip to Helena. The big game winter ranges along the Clark Fork (segment I) receive less snow (50-100 inches; USDA Soil Conservation Service 1975a) than those along the Blackfoot-Clearwater (segment G). Forage produced in rights-of-way may be more accessible to deer and elk in the Clark Fork than in the Blackfoot-Clearwater, and the cover loss may cause less exposure stress. The MacDonald Pass alternative does not cross proposed critical grizzly habitat or subalpine habitat types. This alternative (Broadview to Hot Springs) received a total wildlife impact score of 928, and an impact rating per mile of 2.78. Comparison between link F-I-J-K of the MacDonald Pass alternative and E_1-E_2-E_3-G of the Applicant's proposal (those segments not in common), shows the MacDonald Pass alternative to have a rating of 514 and a per mile rating of 3.56 versus a rating of 560 and a per mile rating of 6.30 for the Applicant's proposal.

Helena (Avon Valley) Alternative

The Avon Valley alternative is 14 miles longer than the Applicant's proposal, but it involves 17 fewer miles of high potential wildlife impacts. It is identical to the MacDonald Pass alternative except for link E_1-E_2-P (Avon Valley) versus link F (MacDonald Pass). The Avon Valley segment involves fewer forested winter ranges than the MacDonald Pass segment. The Avon Valley alternative (Broadview to Hot Springs) received a total wildlife impact score of 892 and a per mile impact rating of 2.67.

Trident-Boulder Alternative

The Trident-Boulder alternative is 13 miles longer than the Applicant's proposal, but crosses 4 fewer miles of high potential wildlife impact areas. This alternative is the same as the Helena alternatives from Garrison to Hot Springs (links I-J-K-L). It has 14 more miles of high potential wildlife impact than the Avon Valley alternative, primarily big game winter range along the Boulder River. These winter ranges receive about the same snowfall as the winter ranges on the Clark Fork. This corridor crosses no proposed critical grizzly bear habitat, and a very limited number of subalpine habitats. The Trident-Boulder alternative (Broadview to Hot Springs), received a total wildlife impact score of 996 and a per mile impact rating of 2.98.

Townsend-Boulder Alternative

The Townsend-Boulder alternative is 12 miles longer than the Applicant's proposal and has 4 more miles of high potential wildlife impact. It is the same as the Trident-Boulder alternative, west of Boulder, but confronts 7 more miles of high potential wildlife impact area, primarily winter ranges along the south edge of the Elkhorn Mountains. This winter range, however, is more open than the timber resources map indicates, and right-of-way clearing impacts along the Elkhorn winter ranges would be minimal. The Townsend-Boulder alternative (Broadview to Hot Springs) received a total wildlife impact rating of 1062 and a per mile impact rating of 3.20.

Butte-Anaconda Alternative

The Butte-Anaconda alternative is 30 miles longer than the Applicant's proposal but confronts 13 fewer miles of high potential wildlife impact areas. Winter ranges confronted are generally less than those along the Applicant's proposal, or the Trident-Boulder, Townsend-Boulder, or Siegel Pass alternatives. No subalpine associations are confronted. The Butte-Anaconda alternative (Broadview to Hot Springs) has a total wildlife impact rating of 974, and a per mile impact rating of 2.78.

Siegel Pass Alternative

The Siegel Pass alternative is identical to the Applicant's proposal from Colstrip to the Nevada Valley. From the Nevada Valley to its terminus near Plains, the Siegel Pass alternative is 15 miles longer than the Applicant's proposal and crosses 10 more miles of high potential wildlife impact areas. The high potential wildlife impacts include general distributions of a number of big game species in the Garnet Range (segment H) and extensive deer and elk winter ranges along Ninemile Creek (segment M). The latter receive moderate to heavy snowfall (50-200 inches, USDA Soil Conservation Service 1975a). No proposed grizzly bear critical habitat would be affected by this alternative. The Siegel Pass alternative (Broadview to Hot Springs) received a total wildlife impact score of 1118, and a per mile impact rating of 3.34. Comparing link H-J-M_1-R-M_3 of the Siegel Pass alternative and link G-L of the Applicant's proposal shows the Siegel Pass alternative to have a impact score of 565 and a per mile impact rating of 5.16 versus 434 and 4.60 for link G-L.

AGRICULTURE

Adverse impacts of a power corridor across agricultural lands include: (a) production loss from land occupied by tower bases and guying cables; (b) production loss from access roads and construction activities; (c) reduced production due to soil compaction, disturbance and erosion caused by construction activities; (d) difficulties in operating automated irrigation equipment; (e) impaired freedom of movement with large field equipment; and (f) nuisance problems related to crop and fence damage, gates left open, improper debris removal, etc. during construction and maintenance. Each of these adverse impacts, except for (f), is unavoidable to a certain extent. This nuisance impact can be avoided by adherence to mitigating measures.

Even with mitigating measures, the remaining impacts could not be totally avoided. They could, however, be reduced in proportion to the reduced number of towers placed on agricultural land and the reduced area of land removed from production. Where towers must be placed on agricultural land there would be associated adverse impacts. Also, crop production would be decreased for a certain period following soil disturbance during construction, an impact which could be mitigated but not avoided. Placing towers on a field with automated irrigation equipment would unavoidably affect the operation of this equipment, in that it would have to be maneuvered around any towers and/or guying cables.

The uniform application of mitigating measures should, in a general sense, decrease overall impacts in proportion to the distance of agricultural lands crossed (see Figure VII-7). If this is the case, impacts should be reduced by some constant percentage regardless of the corridor used. However, there are probably exceptions to this. First, unavoidable impacts on agricultural lands would be greatest where there are large, nearly continuous areas of agricultural fields. In such areas, towers must be located on agricultural fields. Areas of less uniform farmland generally include rough, broken (non-farmed) patches which provide opportunities for tower location (i.e., an effective mitigating measure).

Second, at the scale of mapping employed in this study, it is not possible to show small inclusions of rough or non-farmed patches within the areas mapped as agriculutral lands. Thus, the magnitude of unavoidable impacts on agricultural lands would likely be somewhat different on the three major alternative corridors from Broadview to the Townsend-Trident areas.

Segment B (Great Falls alternative) crosses several areas of extensive dryland farming between Broadview and Judith Gap. Approximately 35 miles of such land would be crossed in this area. Segment D, (Butte-Anaconda alternative) crosses several smaller areas of this nature, the longest of which extends from Broadview to north of Rapelje (about 12 miles). The Sheilds River Valley (about 8 miles), the Sedan area (about 5 miles), and a concentrated farming area just west of Flathead Pass (about 10 miles) are other areas of concern from this standpoint.

Segments D_2 (Trident-Boulder alternative) and Q (Butte-Anaconda alternative) both cross areas of concentrated farming to the northwest (about 8 miles) and west (about 6 miles) of Trident, respectively.

Segment C_1 of the Applicant's proposed corridor crosses about 12 miles of concentrated dryland farming west of Broadview. However, only one other such area (about 3 miles where C_1 crosses the Missouri River flats south of Townsend) occurs on this corridor segment. Of the three alternatives from Broadview, this one would represent the least unavoidable impact on agricultural lands.

In the western portion of the study area, most agricultural areas are interspersed with non-farmed patches; thus mitigation effectiveness in these areas would be more directly related to the length of route crossing farm lands.

URBAN/RESIDENTIAL

During the line location phase of this project, efforts would be made to avoid urban areas and residences. However, with a project of this length, even with the most conscientious planning some homes might have to be removed and others could be visually impacted by the presence of the lines (see Figure VII-8). A certain amount of dust, noise and inconvenience would be inevitable if construction activity occurs in urbanized areas. Occasionally, even with standard industry measures to minimize electrical, radio, and television interference, these problems would remain. Very short-term adverse impacts would result from routine maintenance inspections for the life of the project. Long-term "nuisance" impacts such as unauthorized use of the right-of-way by off-road vehicles probably could not be completely eliminated.

Impacts on urban and residential land use would be most probable in the Helena jurisdictional planning area. The Applicant's proposed corridor and 3 of the 7 alternatives pass through the south and southwest portions of this planning area.

Line routing on the Butte-Anaconda alternative would probably impact urban and residential land uses in the Butte-Silver Bow City County planning area. This alternative is routed south of the city of Butte in an area designated by the county land use plan as an urban growth area. This alternative also would impact an area planned for commercial expansion to the east of Anaconda City.

Five of the 7 alternative corridors would pass through northern Granite County near the community of Dummond, where the only major residential development in the county is expected. These new residential areas would be unavoidably adversely impacted if one of these five alternatives should be selected.

All the corridors pass through Missoula County. Some residences and urban growth areas would be unavoidably adversely impacted. The mountainous terrain in the county would confine both urban development and transmission lines to the river valleys. Thus conflicts would be certain to occur.

RECREATION

The construction and operation of a 450-mile long, twin 500-kV transmission line across nearly three-quarters of Montana, with a continuous right-of-way area of over 16,000 acres would, by its size alone, create impacts on recreation that could not be entirely mitigated.

It is possible that a detailed centerline relocation study of each corridor would either reduce or eliminate some of the impacts shown on Tables VII-16 and VII-19. Such a study, however, is not within the scope of this report; consequently all of the recreation impacts shown on these tables are considered unavoidable and adverse (see Figure VII-9).

Additional special adverse recreation impacts on "one-of-a-kind recreation resources" include:

1. The Blackfoot River Conservation and Recreation Management Area. Located between Potomac and Ovando, Montana, this 30-mile stretch of the Blackfoot River is under a special scenic easement program. Private landowners which include the Nature Conservancy, the Heritage Conservation and Recreation Service, the University of Montana, and others participate in this program. Special Legislation (H.B. No. 341) has been enacted by the State of Montana to protect this scenic easement. Corridor link G, which is part of the Applicant's proposed corridor, would cross part of this scenic easement.

A smaller but similarly protected area lies near Lincoln, Montana, and would be crossed by corridor link B.

2. Information furnished by the U.S. Forest Service and the Bureau of Outdoor Recreation shows a proposed recreation composite area (an area proposed for special recreation funding under the Land and Water Conservation Funding Act) on the Gallatin National Forest (Flathead Pass area northeast of Bozeman, Montana). This composite area would be crossed by corridor link D_1, which would make it the only recreation composite in Montana directly intersected by this project.

3. Corridor link H would cross a potential BLM Wilderness Area in the Wales-Yourname drainages near Greenough, Montana.

4. Corridor links C and F would cross the Colorado-Unionville Planning Unit near Helena, Montana. This unit provides important scenic values and non-motorized, dispersed recreation opportunities to Helena residents.

5. The longest, continuous stretches of high scenic quality (92 miles) in the study area would be crossed by the Applicant's corridor along segment G (between the Blackfoot River and St. Ignatius). Combining this scenic impact with 12 recreation waterway crossings, 87 miles of recreation waterways paralleled, 11 scenic travelways crossings, and 39 miles of scenic travelways paralleled on the same segment, it appears that the Applicant's segment G proposal has the highest potential impact on such activities as driving for pleasure, walking for pleasure, and sightseeing. These activities are the major recreation pursuits in Montana in terms of the number of people participating (see Figure III-18).

   The I-J-K or I-J-M links, which parallel the highly sensitive I-90 Freeway (Garrison to Huson) and principal state highways (such as 93 and 200 from Evaro to Dixon), cross only 9 total miles of high scenic quality lands. Thus, the recreation impacts along segment G appear higher than those along I-J-K, or I-J-M because of the lower scenic quality encountered on the latter. Finally, since Montana residents prefer to recreate in natural undeveloped outdoor recreation areas (see Figure III-16) it seems that a "freeway oriented" alternative corridor (I-J-K or I-J-M) which is already impacted by existing transmission lines would pose less of an impact to recreation than would segment G which crosses more natural undeveloped country.

SPECIALLY MANAGED AREAS

Segment C_1 (Applicant's Proposed Corridor and the Siegel Pass, MacDonald Pass, Avon Valley, and Townsend-Boulder Alternatives) - crosses the northern end of Roadless Area I-742 (RARE II). The roadless area could be avoided by locating the centerline just north of the roadless boundary, still within the corridor. However, recent centerline location studies conducted by the State of Montana indicate that the transmission lines should be located further south. If a southern location were approved, further Federal action on the permit application would have to wait for the RARE II study (described in Chapter III under Specially Managed Areas) and land management planning to be completed. The RARE II study should be completed by December 1978; the land management planning could take an additional two to three years.

Segment C_4 (Applicant's Proposed Corridor and the Siegel Pass, MacDonald Pass, and Avon Valley Alternatives) - passes through the Colorado-Unionville-Travis Planning Unit on the Helena National Forest. The proposed management plan, as detailed in the unit's Draft Environmental Statement, features wildlife habitat, watershed considerations, scenic values from Helena and surrounding areas, and dispersed nonmotorized recreation. The introduction of high voltage transmission lines through this area would conflict with the management goals.

Segment D_1 (Trident-Boulder and Butte-Anaconda Alternatives) - crosses the North Bridger Planning Unit on the Gallatin National Forest where it is routed through Flathead Pass. The drainage basin west of the pass is narrow, with very steep topography and shallow soils. Limestone rock outcrops are common. Two wood-pole, H-frame transmission lines (161-kV and 230-kV) presently occupy this corridor. Adding two 500-kV lines, even if the wood-pole lines were removed, would cause high construction and visual impacts, thus reducing the value of the recreation experience afforded here.

This segment also crosses the north edge of the Hailstone National Wildlife Refuge. Here, the powerlines would pose collision obstacles to the waterfowl using the refuge. This physical threat could be reduced by placing the powerlines outside the refuge. Placing them two miles away would result in only minimal impact on the waterfowl resource (Lee 1978).

Segment D_3 (Townsend-Boulder and Trident-Boulder Alternatives) - traverses the Basin Planning Unit on the Deerlodge National Forest. National Forest management direction for this area is to maintain or enhance wildlife and to protect the aesthetic qualities of the area. Emphasis is on maintaining winter range for deer and elk. Although the impacts associated with the introduction of the powerlines could be mitigated to some degree, conflicts between powerlines and management directions would still exist.

Segment F (MacDonald Pass Alternative) - also crosses a portion of the Colorado-Unionville-Travis Planning Unit. The impacts described under segment C_4 also apply here.

Segment G (Applicant's Proposed Corridor and Great Falls Alternative) - is located close to the National Bison Range. Powerlines would be a visual intrusion for the visitors using the self-conducted auto tour. Viewing and photographing the bison and other wildlife with the Mission Mountains as a backdrop would be impacted.

Segment H (Siegel Pass Alternative) - crosses a potential wilderness study area on Bureau of Land Management land. BLM is deferring action on any proposal that would change the wilderness character of the area until a wilderness study can be completed, but no timetable has been set for accomplishing this study.

Segment M_1 (Siegel Pass Alternative) - traverses the Ninemile-Mill Planning Unit on the Lolo National Forest. Management objectives and guidance for the area crossed by the transmission line corridor emphasize the aesthetic or recreation attributes of the area, and the introduction of two parallel 500-kV transmission lines would cause impacts of sufficient magnitude to be in conflict with these objectives.

Segment R (Siegel Pass Alternative) - crosses Roadless Area I-796 (RARE II), located within the Sacajawea-Cutoff Planning Unit on the Lolo National Forest. If this segment were included in an approved corridor, further action on the permit application would be delayed until the land management plan and/or the RARE II study (see Chapter III) are completed. The RARE II study is scheduled for completion by December 1978. However, the land management plan is scheduled to be completed by October 1978, and this plan will contain management direction and guidance for the land included in the roadless area.

SOCIAL AND ECONOMIC

Communities along the selected route would unavoidably be impacted by an influx of construction workers and some of their dependents (see Figure VII-8). Whether this influx would be a beneficial or adverse impact would depend on several factors, e.g., the size of the influx, the size of the community, the compatibility of the lifestyles of the in-migrants and the residents, the duration of the influx, and the availability of needed goods and services. It would also depend on the point of view of the person making that assessment (i.e., some people would benefit from the increase and thus view it as a beneficial impact and others, who value the maintenance of existing lifestyle above all else, would view any change as detrimental). No definitive statement can be made about whether there would be unavoidable adverse social and economic impacts until after completion of the project.

VISUAL

As for recreation resources, constructing this project, would by its size alone create visual impacts that could not be entirely mitigated.

The mitigating measures recommended in Chapter VIII could significantly reduce potential visual impacts. To minimize visual impacts it is essential that each agency involved in granting easement permits conduct a site specific evaluation of visual contrasts on lands under their jurisdiction during centerline location. The project would, nevertheless, under the best of conditions, produce substantial unavoidable visual impacts. Areas with the highest potential for residual impacts are shown in Figure VII-14.

PREHISTORIC AND HISTORIC

Unavoidable impacts on prehistoric and historic resources could be mitigated by appropriate measures developed in consultation with the State Historic Preservation Officer and in accordance with procedures for comment by the National Advisory Council on Historic Preservation, prescribed by the National Historic Preservation Act of 1966 and 36 CFR 800.

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

SHORT-TERM/LONG-TERM

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

GENERAL STATEMENT

The high-voltage facilities proposed for construction (transmission lines with steel supporting towers and associated substations) have an expected average useful life of 50 years. Some of the environmental consequences associated with creation of the facility could be considered short term. These are primarily associated with the construction activity itself, and vary in duration. Construction activity would interfere with the use of the land within the corridor while construction is underway (generally 3 months to 2 years for a specific location), and might also disturb nearby wildlife and residents by noise, dust, and visibility of men and equipment. Some short term construction impacts might extend beyond the actual construction period, especially those principally associated with the disturbance of vegetation by construction activities. Among such impacts are changes of habitat for certain wildlife species within the corridor, increased erosion, and resultant siltation; these impacts generally subside with the regrowth of natural or introduced vegetation. Short-term impacts are covered in more detail in Chapter VII.

The long-term impacts on the environment and productivity, including the increased productivity of other activities resulting from the availability of electric energy, would depend directly on the continued existence of the transmission facility itself. Productivity resulting from the use of the electricity provided by new facilities would be substantially the same over the life of the facility. Similarly, adverse effects on productivity, which are primarily related to land use considerations, would last as long as the facility remains in place.

Should changes in technology make a transmission line obsolete, it could be dismantled and removed, although past experience indicates that corridors are usually upgraded to higher capacity as technology advances, rather than being entirely removed from service. Retirement would permit substantial return of the area to its natural state (vegetative regrowth might take several years), which would terminate any adverse impact on land and its productivity directly created by the line, and would also terminate the benefits to productivity resulting from the availability of the power provided. Retirement and removal of the line would make the corridor available for a full range of other uses. However, if adjacent land use patterns (at the time of dismantling) had been modified by the existence of the line, the economic uses of the corridor might continue to be limited after removal of the line. No other direct long-term impacts on productivity have been identified.

RESOURCE SPECIFIC STATEMENTS

SOILS

Most of the damage to the soil resource from accelerated erosion, compaction, and obliteration of soil profiles would occur in the short-term (during the construction period). The mitigating measures recommended in this report would restrict the occurrence of these impacts to the construction period. However, the effects of these impacts would definitely be long-term. Many years would be required to replace the soil lost through erosion, to nullify the effects of soil compaction, and to redevelop the soil profile.

The loss of soil nutrients through increased leaching would occur as long as the transmission line corridors are maintained. However, if soil nutrients were replaced with fertilizer, the loss of soil nutrients would have no adverse effect on long-term productivity.

SURFACE WATER

Applying the mitigating measures as recommended in this report would limit increases in sediment and turbidity to the short-term (the construction period) and prevent adverse effects on long-term productivity.

Not using these measures could allow erosion and sedimentation to continue for many years, which in turn could ruin fish spawning beds by siltation and permanently decrease the water quality, therefore having an adverse effect on long-term productivity.

Increases in water yield, dissolved solids, and water temperature would persist as long as the transmission line corridor is maintained and vegetation is prevented from reaching its pre-construction density and height. Because these impacts would not be of large magnitude, they would not be expected, by themselves, to have a significant adverse effect on long-term productivity. However, should these impacts be combined with similar impacts from other projects (highways, pipeline corridors, timber harvests), the synergistic adverse effects on long-term productivity could be significant.

RANGELAND

Long-term productivity would be affected by this project by the permanent removal of vegetation for project facilities. Even though temporarily disturbed areas would be reclaimed, the time required to return to pre-construction levels of productivity would vary. The long-term productivity of the natural vegetation is closely related to the average annual precipitation. Where this exceeds 15 inches, there would be only short-term losses in rangeland productivity on temporarily disturbed areas, providing that the soil profile had not been drastically altered.

In addition to lost productivity on acreage permanently removed, the project could affect short-term uses on temporarily disturbed areas. As much of the study area is semi-arid, the natural recovery of vegetation in many places would have to be considered a long-term process. Further compounding the problem of reduced productivity and increased recovery time in semi-arid areas would be reduction in potential for successful reclamation.

During the first year or two after construction, vegetative cover would be composed predominantly of annual forbs and grasses with little forage available for herbivores. During intermediate successional stages, the composition of the vegetative cover would shift to grasses as perennial grass species become established. Generally, in about the fourth or fifth year, productivity should approach that of adjacent undisturbed areas. Where soil profile mixing might have displaced most of the topsoil, however, recovery would take longer.

Where annual rainfall is less than 15 inches per year, it could take 10 or more years for rangeland to recover to pre-construction conditions, as the time required for re-establishment of native vegetation is influenced primarily by the amount of annual rainfall. Topographic features, soil fertility, and proximity and abundance of remnant perennial grasses adjacent to the construction zone also influence recovery time.

Revegetation by seeding could shorten the recovery period, if there is sufficient precipitation and if the seeded area could be protected from livestock grazing for at least 2, and preferably 3, years. Seeding is generally unreliable if annual precipitation is less than 12 to 13 inches.

Productivity permanently removed (for the life of the project and most likely beyond) would vary from approximately 282 to 356 AUM's per year (Table VII-6), depending on the corridor selected. This production presently helps support a wide and diverse variety of animal life, including livestock.

The proposal would represent a long-term commitment of land, and reduced vegetative productivity would undoubtedly continue beyond the projected 50-year life of this project. The right-of-way would remain in use as long as there would be a need to transport energy across the Montana portion of the Rocky Mountains. Constructing the proposed transmission line to supply present needs would also commit the land within the corridor to projected future needs: any future energy transportation systems would probably be constructed along the same corridor, thereby concentrating future impacts within a defined area. This long-term loss of vegetation--a trade-off for energy distribution--would adversely affect, to some degree, all animals presently obtaining food and cover along any corridor selected.

FOREST LAND

Accommodating the transmission line right-of-way and the access roads would cause a long-term loss of commercial timber production. Acres and volumes that would be removed for each of the corridors are presented in Table VI-6. Potential productivity losses, which would vary from 35 to 95 cubic feet per acre, depending on the timber type, are summarized for each corridor as follows:

CORRIDOR	LENGTH (miles)	COMMERCIAL FOREST LAND (miles)	POTENTIAL PRODUCTIVITY LOST (MCF per year)
Applicant's Proposed	431.3	91.8	303
Siegel Pass	446.3	106.1	365
Great Falls	447.6	94.7	316
Helena (MacDonald Pass)	445.3	49.8	149
Helena (Avon Valley)	445.7	63.3	197
Townsend-Boulder	443.2	73.5	231
Trident-Boulder	445.4	66.6	200
Butte-Anaconda	461.2	50.0	143

FISH AND WILDLIFE

The proposed extra high-voltage transmission line may not be a short-term use of the environment. The life of the line could extend well past the projected life of the coal-fired generation, if other power sources such as solar power are developed in the Colstrip area.

Assuming the projected economic life of 50 years to be a short-term use of the environment, and evaluating the proposed transmission line in isolation, no measurable long-term compromise of wildlife productivity would be expected. Relatively few animals would be destroyed by construction activity although losses would occur as a result of stress. Stress may either predispose individuals to other mortality factors, or lower the birthrate by reducing fecundity. Generally, these losses would represent very small portions of the populations involved, and recovery of losses after the line is removed should be complete.

Should, however, the proposed transmission line result in increased development, further eroding wildlife habitat, recovery of that habitat would be less certain and might not be complete. Additional development could further compromise habitat during the life of this line, the cumulative effect being an unrecoverable loss of habitat or animals.

AGRICULTURE

Some impacts on agricultural lands crossed by a power corridor are directly related to construction activities and should not endure for more than 2-3 years; hence they would not significantly influence long-term agricultural productivity. Others would endure as long as the towers remain in position.

Short-term impacts which would not be expected to interfere with long-term agricultural production are: (a) production loss from access roads and construction activities; and (b) reduced production due to soil compaction, disturbance, or erosion caused by construction activities. Long-term impacts include: (a) production loss from land occupied by tower bases and guying cables; (b) difficulties in operating automated irrigation equipment; and (c) impaired freedom of movement of large field equipment. Nuisance impacts related to crop and fence damage, gates left open, improper debris removal, etc. during construction and maintenance, could be either short- or long-term. Only minor impacts resulting from maintenance activities would endure for the lifetime of the project.

No enhancement of long-term productivity would be expected from any construction, maintenance, operation or final project removal activities. At such a time that the project would no longer be functional and might be removed, productivity could be restored to the land areas previously occupied. Subsequent long-term agricultural production would be expected to recover completely within a few years.

URBAN/RESIDENTIAL

In determining a transmission line route, efforts would be made to avoid existing urban and residential development. In some areas the line would be routed around the fringe areas of existing and developing communities. In mountainous areas, the lines would have to be confined to the same area most suited to urban growth. Thus, in the short-term, the lines would be sited to minimize conflicts with existing development, but future development patterns might be affected by the presence of the lines and the resultant restrictions on development. In addition, constructing this line would increase the probability that future lines would be located in the same or a widened right-of-way.

RECREATION

Short-term impacts on recreation would be primarily associated with traffic control measures needed for construction activities (such as temporary detours and road closures) and the sudden appearance of man-made, unnatural intrusions on the recreation environment that could only be partially mitigated. Temporary traffic changes are generally well accepted by the public. People are, however, becoming less tolerant of obvious landscape scars and structural intrusions. Public reaction to short-term impacts on or near key outdoor recreation areas can be greater than its concern for some of the long-term impacts on other, seldom seen areas.

Each of the six general categories of impacts listed in Chapter VII involves long-term (for the life of the project) commitments of recreation resources. The construction and operation of twin 500-kV lines could, in the long-term:

1. Preclude the use of certain existing and potential developed recreation sites;

2. Act as a barrier to certain kinds of recreation activities;

3. Pose a hazard to certain kinds of recreation activities;

4. Reduce the quality of the recreation experience in certain areas;

5. Open new recreation travel routes to off-road vehicles;

6. Depreciate recreation land values on both public and private lands; and

7. Cause a loss of income as a result of the six preceeding impacts.

Should the line be removed in the future because of technological breakthroughs, it would be quite probable that some of the adverse impacts could be reversed. It would be equally probable, however, that in certain areas, such adverse impacts as new travel routes opened or roadless areas compromised could not be reversed.

SOCIAL AND ECONOMIC

Construction of this project should have little long-term social impact. Because of the short time the construction workers would be in a community, no permanent changes or improvements would likely be made to accommodate the influx. Most of the temporary measures employed to assure the newcomers the goods and services they need could be dropped or reversed after completion of construction work. Similarly, potential conflicts between the in-migrant workers and local residents would last only as long as the newcomers stay in the community. Presumably any in-migrant who chooses to settle in a community does so because of a perceived compatibility with the residents and their lifestyles. Property tax revenues would be generated by the transmission lines and switchyards. These revenues would be considered to be a long-term impact.

VISUAL

Impact from placement of a transmission line and its supporting facilities in natural, rural or urban landscapes would be considered long-term if it could not be mitigated (screened or otherwise blended into the visual environment) within ten years (USDA, AG Hbk. No. 483).

Within the Colstrip study area, the construction and operation of a 450-mile transmission line (with towers from 66 to over 175 feet high and cleared rights-of-way up to 300 feet wide in forested areas) and its supporting facilities would constitute a long-term impact on the visual environment.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Construction and maintenance of facilities included in this project proposal would require clearing and disposal of approximately 2,000-4,500 acres of timber from forested land depending on which alternative corridor is selected. This land would be committed to other uses such as agriculture, range, or recreation for the life of the transmission facilities, or it might become unused except by wildlife. Should the new transmission facilities be eventually retired, a return to the original forested state would be possible. This would take from approximately 20 to 50 years, depending upon location, although tree growth would begin to provide substantial ground cover after about 20 years. In addition, approximately 200-300 acres of agricultural, range, and other land would be occupied by towers, substations, and other types of structures, representing a comparatively permanent use of the land.

The loss of soil through accelerated erosion would not be irreversible: accelerated erosion could be halted by revegetation and other mitigating measures recommended in this report. However, soil lost through erosion before mitigating measures take effect would be irretrievable. Soil compaction, obliteration of the soil profile, and the loss of soil nutrients would be, for the most part, irreversible within the life span of the project. Soil forming processes working over a long period of years would ameliorate these impacts; therefore, in the very long-term, the soil would not be irretrievably committed.

Surface water impacted by the project would not be irreversibly or irretrievably committed. Increases in sediment and turbidity would likely degrade water quality so as to alter its potential use. Degradation could be prevented with the mitigating measures recommended in this report, and any degradation resulting from sedimentation could be reversed (see Chapter VIII). Surface water degraded with sediment could be treated and purified. The commitment of surface water would not, therefore, be irretrievable.

Irretrievable commitments of vegetation would be limited to those individual plants lost during construction and maintenance of the proposed facilities, as well as the reduced number of animal unit months (AUMs) of livestock grazing. In the future, it is conceivable that the project could be abandoned, all facilities removed, and native vegetation allowed to reestablish. Therefore, this proposed project could not be considered an irreversible commitment of the vegetative resource, although right-of-way and access road clearing and continued control of tree growth would result in an irretrievable timber production loss.

The maintenance of early seral forest communities and new access roads is an irreversible commitment of wildlife resources, to the degree that it causes additional physiological stress on or destruction of individual animals. Physiological stress might predispose individuals to mortality, or reduced fecundity (capacity to successfully produce and rear young). Direct mortality of individuals might be caused by crushing, collision (with vehicles or structures) or shooting (legal and illegal). Although the loss of individual animals would be an irretrievable commitment of those animals, it would not be an irretrievable commitment of any fish or wildlife species, with the possible exception of endangered and threatened species. However, the destruction of individuals of any identified threatened or endangered species is considered to be a very remote possibility. Loss of habitat would be an irretrievable commitment of resource only where road construction and scarification around construction sites would expose soils which would not become revegetated. Stream bank construction activity (fording, culvert installation) or land failure might introduce sediment loads which would irretrievably compromise fish production for that year.

During the life of the facilities, certain uses of the land would be restricted, limiting the range of beneficial uses of the land involved. Principally, large structures would be restricted from the right-of-way, preventing the use of the right-of-way for residential, commercial, industrial, and agricultural buildings. However, because of the linear nature of a right-of-way, other suitable lands would generally be available nearby.

For agricultural lands, only the land occupied by tower bases, guying cables or ancillary facilities would be irreversibly committed. These areas would not be available for agricultural production during the lifetime of the project. Irretrievable resources include agricultural products which could not be produced on lands removed from production, either during construction or permanently. As a portion of total agricultural production within the area, the loss of resources would be insignificant.

Certain types of agricultural activities, such as wheel and circular irrigation, which depend on large areas of unobstructed access, might be affected. Where these activities are practiced, construction of the proposed facilities might necessitate adjustments in crop layout to obtain optimal use of the land; small portions of a holding might, in some cases, become uneconomic to farm. Where these situations occur, the landowner would be compensated.

In theory, the right-of-way for this transmission line could, when abondoned, be developed to urban and residential land uses so that no irreversible and irretrievable commitment of land would occur. In reality, however, line location would have an irreversible impact on urban growth patterns. Transmission lines are generally considered more compatible with industrial or commercial land use than with residential land use. Locating a line on the fringe of a developing area would likely cause the area to be developed to those uses rather than to residential uses. Once an area is urbanized, the urban land use pattern does not generally change.

All of the mitigation practices recommended in Chapter VIII of this report would reduce, to some degree, the impact on recreation resources. However, because outdoor recreation relies heavily upon the "visual environment," the physical presence of the transmission line and its supporting facilities would be the major recreation impact. Without a detailed seen-area analysis to determine which recreation sites and areas would not be within viewing distance of the transmission line, all of the measured impacts on recreation resources identified in Chapter

VII must be considered irreversible for the life of the project. The relative importance of these recreation impacts would vary from area to area.

Visual impacts remaining after restoration and revegetation of construction-related scars would exist as long as the transmission lines are maintained. If the corridor were abondoned and towers and lines removed, many areas would in time revegetate, reducing contrasts and visibility of the project. In areas where soil erosion and difficult growing conditions make revegetation imperceptibly slow, the visual impacts could be considered irreversible.

It is reasonable to expect that some prehistoric or historic resources would be impacted. Such impact would be irreversible and the resource irretrievable, in that its setting would have been both physically and visually altered.

In addition to the commitment of land resources, several thousand tons of steel and aluminum required for the manufacture of the tower structures and conductor would be irreversibly committed to transmission uses. If any of this equipment should later be retired, materials used in their construction could probably be reused elsewhere or recycled.

APPENDICES

Table A-1-1 - SELECTED MONTANA MAMMALS SPECIES LIST

SPECIES	STATUS						DISTRIBUTION		
	Game	Fur-Bearer	Predator	Special	Threatened	Endangered	Range in Study Area	Range Confronted 1/	Habitat Confronted 1/
1. Merriams shrew (Sorex merriami)				*			*	*	*
2. Dwarf shrew (S. nanus)				*			*	–	–
3. Prebles shrew (S. preblei)				*			*	*	*
4. Pigmy shrew (Microsorex hoyi)				*			*	*	*
5. California bat (Myotis californicus)				*			*	*	–
6. Long-legged bat (Myotis volans)				*			*	*	*
7. Fringed bat (Myotis thysanodes)				*			*	*	–
8. Spotted bat (Euderma maculatum)				*			*	*	–
9. Big-eared bat (Plecotus townsendii)				*			*	*	–
10. Black bear (Ursus americanus)	*						*	*	*
11. Grizzly bear (Ursus arctos horribilis)	*				*		*	*	*
12. Fisher (Martes pennanti)		*					*	*	*
13. Marten (Martes americana)		*					*	*	*
14. Short-tailed weasel (Mustela erminea)			*				*	*	*
15. Long-tailed weasel (Mustela frenata)			*				*	*	*
16. Least weasel (Mustela nivalis)			*	*			*	*	*
17. Mink (Mustela vison)		*					*	*	*
18. Black-footed ferret (Mustela nigripes)				*		*	*	*	*
19. Wolverine (Gulo gulo)				*			*	*	*
20. Striped skunk (Mephitis mephitis)			*				*	*	*
21. Spotted skunk (Spilogale putoris)			*	*			–	–	–
22. River otter (Lutra canadensis)		*					*	*	*
23. Swift fox (Vulpes velox)				*			–	–	–
24. Coyote (Canis latrans)			*				*	*	*
25. Wolf (Canis lupus irremotus)				*		*	*	*	–
26. Cougar (Felis concolor)	*						*	*	*
27. Canada lynx (Lynx canadensis)				*			*	*	*
28. Bobcat (Lynx rufus)			*				*	*	*
29. Hoary marmot (Marmota caligata)				*			*	–	–
30. Uinta ground squirrel (Spermophilus armatus)				*			–	–	–

Table A-1-1 - SELECTED MONTANA MAMMALS SPECIES LIST (Continued)

SPECIES	STATUS						DISTRIBUTION		
	Game	Fur-Bearer	Predator	Special	Threatened	Endangered	Range In Study Area	Range Confronted 1/	Habitat Confronted 1/
31. Black-tailed prairie dog (Cynomis ludovicianus)				*			*	*	?
32. White-tailed prairie dog (Cynomis leucurus)				*			-	-	-
33. Uinta chipmunk (Eutamias umbrinus)				*			*	-	-
34. Great basin pocket mouse (Perognathus parvus)				*			-	-	-
35. Hispid pocket mouse (Perognathus hispidus)				*			-	-	-
36. Beaver (Castor canadensis)		*					*	*	*
37. Northern bog lemming (Synaptomis borealis)				*			-	-	-
38. Muskrat (Ondatra zibethicus)		*					*	*	*
39. Meadow jumping mouse (Zapus hudsonicus)				*			-	-	-
40. Black-tailed jackrabiit (Lepus californicus)				*			-	-	-
41. Pigmy rabbit (Sylvilagus idahoensis)				*			-	-	-
42. Elk (Cervus canadensis)	*						-	-	-
43. White-tailed deer (Odocoileus virginianus)	*						*	*	*
44. Mule deer (Odocoileus hemionus)	*						*	*	*
45. Moose (Alces alces)	*						*	*	*
46. Woodland caribou (Rangifer tarandus)	*			*			-	-	-
47. Am. pronghorn (Antilocapra americana)	*						*	*	-
48. Bison (Bison bison)	*						*	-	-
49. Bighorn sheep (Ovis canadensis)	*						*	-	-
50. Mountain goat (Oreamnos americanus)	*						*	-	-

[1/] Confronted by corridors and problem area alternatives (steps 2 & 3)

Sources: Flath (1977) Hoffman & Pattie (1968) Hoffman, Pattie & Bell (1969) Hoffman, Wright & Newby (1969).

Table A-1-2 - SELECTED MONTANA BIRDS SPECIES LIST

SPECIES	STATUS					OCCURRENCE			
	Waterfowl	Upland Gamebird	Special	Threatened	Endangered	Seldom Seen	Migrant	Winters	Nests
1. Whistling swan (Olor columbianus)	*						*		
2. Trumpeter swan (Olor buccinator)	*							*	*
3. Canada goose (Branta canadensis)	*							*	*
4. Black brant (Branta nigricans)	*					*	*		
5. White-fronted goose (Anser albifrons)	*						*		
6. Snow goose (Chen hyperborea)	*						*		
7. Ross goose (Chen rosii)	*						*		
8. Mallard (Anas platyrhynchos)	*							*	*
9. Black duck (Anas rubripes)	*					*			
10. Gadwall (Anas stepera)	*								*
11. Pintail (Anas acuta)	*							*	*
12. Green-wing teal (Anas carolinensis)	*							*	*
13. Blue-wing teal (Anas discors)	*								*
14. Cinnamon teal (Anas crecca)	*								*
15. European wigeon (Mareca penelope)	*					*			
16. American wigeon (Mareca americana)	*							*	*
17. Northern shoveler (Spatula clypeata)	*							*	*
18. Wood duck (Aix spansa)	*								*
19. Redhead (Aythya americana)	*								*
20. Ring-necked duck (Aythya collaris)	*								*
21. Canvasback (Aythya valisineria)	*								*
22. Greater scaup (Aythya marila)	*					*			
23. Lesser scaup (Aythya affinis)	*								*
24. Common goldeneye (Bucephala clangula)	*							*	*
25. Barrow's goldeneye (Bucephala islandica)	*							*	*
26. Bufflehead (Bucephala albeola)	*								*
27. Oldsquaw (Clangula hyemalis)	*						*		
28. Harlequin duck (Histrionicus histrionicus)	*							*	*
29. White-winged scoter (Melanitta deglandi)	*						*		
30. Surf scoter (Melaniitta perspicillata)	*						*		
31. Ruddy duck (Oxyura jamaicensis)	*								*
32. Hooded merganser (Lophodytes cucullatus)	*								*

Table A-1-2 - SELECTED MONTANA BIRDS SPECIES LIST (Continued)

SPECIES	STATUS					OCCURRENCE			
	Waterfowl	Upland Gamebird	Special	Threatened	Endangered	Seldom Seen	Migrant	Winters	Nests
33. Common merganser (Mergus merganser)	*							*	*
34. Red-breasted merganser (Mergus serrator)	*								*
35. Goshawk (Accipiter gentilis)			*					*	*
36. Sharp-shinned hawk (Accipiter striatus)			*					*	*
37. Cooper's hawk (Accipiter cooperii)			*						*
38. Ferruginous hawk (Buteo jamaicensis)			*						*
39. Golden eagle (Aquila chrysaetos)			*					*	*
40. Bald eagle (Haliaeetus leucocephalus)			*					*	*
41. Marsh hawk (Circus cyaneus)			*					*	*
42. Osprey (Pandion haliaetus)			*						*
43. Gyrfalcon (Falco rusticolus)			*					*	
44. Prairie falcon (Falco mexicanus)			*					*	*
45. Peregrine falcon (Falco peregrinus)			*		*			*	*
46. Merlin (Falco columbarius)			*					*	*
47. Blue grouse (Dendragapus obscurus)		*						*	*
48. Spruce grouse (Canachites canadensis)		*						*	*
49. Ruffed grouse (Bonasa umbellus)		*						*	*
50. White-tailed ptarmigan (Lagopus lexinrus)		*						*	*
51. Sharp-tailed grouse (Pediocetes phasianellus)		*						*	*
52. Sage grouse (Centrocercus urophasianus)		*						*	*
53. Ring-necked pheasant (Phasianus colchicos)		*						*	*
54. Chukar (Alectoris graeca)		*						*	*
55. Hungarian partridge (Perdix perdix)		*						*	*
56. Turkey (Meleagris gallopavo)		*						*	*
57. Whooping crane (Grus americana)					*		*		
58. Piping plover (Charadrius melodus)						*			*
59. Mountain plover (Eupoda montana)									*
60. Am. golden plover (Pluvialis dominica)						*	*		
61. Ruddy turnstone (Arenaris melanocephala)						*	*		
62. Red knot (Calidris canutus)						*	*		
63. Dunlin (Erolia alpina)						*	*		
64. Short-billed dowitcher (Limnodromus griseus)						*	*		
65. Semipalmated sandpier (Ereunetes pusillus)							*		
66. Western sandpiper (Ereunetes mauri)							*		

Table A-1-2 - SELECTED MONTANA BIRDS SPECIES LIST (Continued)

SPECIES	STATUS					OCCURRENCE			
	Waterfowl	Upland Gamebird	Special	Threatened	Endangered	Seldom Seen	Migrant	Winters	Nests
67. Sanderling (Crocethia alba)							*		
68. Black-necked stilt (Himantopus mexicanus)						*	*		
69. Screech owl (Otus asio)								*	*
70. Snowy owl (Nyctea scandiaca)						*		*	
71. Pygmy owl (Glaucidium gnoma)								*	*
72. Burrowing owl (Speotyto cunicularia)									*
73. Barred owl (Strix varia)						*			*
74. Great gray owl (Strix nebulosa)						*		*	*
75. Long eared owl (Asio otus)								*	*
76. Boreal owl (Aegolius funereus)						*		*	
77. Saw-whet owl (Aegolius acadicus)								*	*
78. Williamson's sapsucker (Sphyrapicus thyoideus)									*
79. Black-backed 3-toed woodpecker (Picoides arcticus)								*	*
80. Northern 3-toed woodpecker (Picoides tridactylus)								*	*
81. Eastern bluebird (Sialia sialis)						*			*
82. Western bluebird (Sialia mexicana)						*		*	*
83. Dickcissel (Spiza americana)									*

Source: Flath (1977); Davis (1973)

Table A-1-3 - MONTANA REPTILES AND AMPHIBIANS OF SPECIAL INTEREST OR CONCERN SPECIES LIST

Species	In Study Area
Snapping turtle (*Chelydra serpentina*)	Yes
Spiny softshell (*Triony spiniferous*)	Yes
Milk snake (*Lampropeltis triangulum*)	No
Plains hognose (*Heterodon nasicus*)	Yes
Couerd'Alene salamander (*Plethodon vandykei*)	Not confirmed
Pacific giant salamander (*Dicampton cusatus*)	No
Tailed frog (*Ascaphus truei*)	Yes
Dakota toad (*Bufo hemiophrys*)	No
Spotted chorus frog (*Pseudacris clarki*)	No
Wood frog (*Rana sylvatica*)	No
Bull frog (*Rana catesbiana*)	Yes

Source: Flath 1977.

Appendix A-8

SCENIC QUALITY RATING CRITERIA (STEP 1)

Scenery and Development Impact Capacity (DIC) Rating Criteria

No.	Criteria	Scenery Rating	DIC Rating
1.	BASIC TERRAIN VARIETY		
a.	Subsection characterized by highly varied terrain, dramatic slope gradient and relief differences typical. The area is dominated by massive angular forms, sharp edge definition, strong visual contrast.	24 22 20	8 9 12
b.	Subsection contains moderately varied terrain, dominated by fairly massive, rounded forms, moderate edge definition, moderate visual contrast.	16 14 12	14 16 20
c.	Subsection characterized by uniform terrain, predominantly gently sloping forms, subtle edge definitions, weak visual contrast.	8 6	22 24
2.	GEOLOGIC FEATURES VARIETY		
a.	Subsections characterized by numerous and/or highly significant geologic features (e.g., high cliffs, massive rock formations, rugged peaks and/or rugged chasms, gorges), major figure objects which tend to dominate other objects in the visual field.	16 14	
b.	Subsections characterized by moderately significant geologic features (minor cliffs and rock formations are typical examples); these figure objects tend toward co-dominance with other objects in the visual field.	10 8	

Appendix A-2

SCENIC QUALITY RATING CRITERIA (STEP 1)

Scenery and Development Impact Capacity (DIC) Rating Criteria

No.	Criteria	Scenery Rating	DIC Rating
1.	BASIC TERRAIN VARIETY		
a.	Subsection characterized by highly varied terrain, dramatic slope gradient and relief differences typical. The area is dominated by massive angular forms, sharp edge definitions, strong visual contrast.	24 22 20	6 8 12
b.	Subsection contains moderately varied terrain, dominated by fairly massive, rounded forms, moderate edge definition, moderate visual contrast.	16 14 12	14 16 20
c.	Subsection characterized by uniform terrain, predominantly gently sloping forms, subtle edge definitions, weak visual contrast.	8 6	22 24
2.	GEOLOGIC FEATURES VARIETY		
a.	Subsection characterized by numerous and/or highly significant geologic features (e.g., high cliffs, massive rock formations, craggy peaks and/or ridges, chasms, gorges); major figure objects which tend to dominate other objects in the visual field.	14 12	
b.	Subsections characterized by moderately significant geologic features (minor cliffs and rock formations are typical examples); these figure objects tend toward co-dominance with other objects in the visual field.	10 8	

No.	Criteria	Scenery Rating	DIC Rating
2.	GEOLOGIC FEATURES VARIETY (Continued)		
c.	Subsection characterized by minor, or no geologic features; when present minor features are usually subordinate to other objects of the visual field.	4 2	
3.	WATER FEATURES VARIETY		
a.	Subsection characterized by a generous distribution of significant water features. (Lakes, marshes, rivers, large streams, waterfalls, snowfields are typical examples.) These feature objects tend to dominate other objects of the visual field.	18 16 14	
b.	Subsection characterized by moderately significant water features (small isolated lakes and/or marshes, moderate sized streams, small waterfalls are typical examples). These figure objects tend toward co-dominance with other objects of the visual fields.	12 10 8 6	
c.	Subsection characterized by minor or no water features (eg., minor or intermittent streams, small marshy areas, etc.); these features, when present, are usually subordinate to other objects of the visual field.	4 2	
4.	VEGETATIVE PATTERN VARIETY		
a.	Subsection characterized by contrasting vegetative pattern and texture expressed through varied structural types. Variety of vegetative communities creates contrasting forms and color in the landscape. Forest openings and/or patches are major figure objects which may dominate or be co-dominant with other objects of the visual field.	12 10	12 10

No.	Criteria	Scenery Rating	DIC Rating
A.	VEGETATIVE PATTERN VARIETY (Continued)		
b.	Subsection characterized by moderately varied vegetative pattern and texture (presence of few vegetative communities and structural type typical); minor changes of form and color are evident. Natural forest openings or isolated forest patches are not distinct due to subtle edge definition; forest openings and/or patches tend toward co-dominance or subordination with other objects of the visual field.	8 6	8 6
c.	Subsection characterized by uniform pattern of vegetation (presence of only one type of plant community typical), lack of structural variety eliminates textural variations. Vegetative cover tends to be ground in relation to other objects of the visual field.	4 2	4 2
5.	LAND USE EFFECTS		
a.	Subsection characterized by cultural effects which enhance the stimulus potential of the visual field. Well kept meadows and pastures with grazing cattle are typical. Structures including fences, barns, and houses are in harmony with their surroundings and reflect the historic development of the area.	8 6 4 2	0 0 0 0
b.	Subsection characterized by the absence of discordant land use effects; existing land use effects, if discernible are in harmony with the natural objects of the visual field.	0	0

No.	Criteria	Scenery Rating	DIC Rating
5.	LAND USE EFFECTS		
c.	Subsection characterized by the presence of moderately discordant land use effects, these effects tend toward co-dominance with the natural objects of the visual field.	-2 -4	-2 -4
d.	Subsection characterized by the presence of highly discordant land use effects; these effects tend to dominate the natural objects of the visual field.	-6	-8

Source: Joppa 1974.

Appendix B-7

RECREATION SUITABILITY EVALUATION FORM

Recreation

1. Land Unit(s) ________________
2. Segment ____________ Segment Subunit No. ________
3. Segment Length ________ Subunit Length ________
4. General Comments ______________________
5. Evaluator ______________ Date ____________

[illegible]	Multiplier	Raw Score	Weighted Score
6.	[illegible]		
7.	[illegible]		
8.	[illegible]		
9.	[illegible]		
10.	[illegible]		
11.	[illegible]		
12.	Total Score		
13.	Per Mile Value		

6. Existing Developed Sites and Intensive Use Areas				
	Distance Miles			
	0-2	2-6	6-12	12+
Score	4	2	1	0
a. Developed Sites				
b. Intensive Use Areas				
Subtotal Score				
Subtotal Raw Score				

7. Potential Sites and Areas				
	Distance Miles			
	0-2	2-6	6-12	12+
Score	4	2	1	0
a. B.O.R. Recreation Potential Inventory				
b. Recreation Inventory of Montana Waterways				
c. Montana State Potential Areas				
d. Montana State Long Range Recreation Improvement Program				
Subtotal Score				
Subtotal Raw Score				

Appendix A-3

RECREATION SUITABILITY EVALUATION FORM

Recreation

1. Land Unit(s) ______________

2. Segment ____________ Segment Subunit No. ________

3. Segment Length ________ Subunit Length ________

4. General Comments ______________________________

5. Evaluator ____________ Date ____________

Score Table Item	Multiplier	Raw Score	Weighted Score
6.	x1		
7.	x2		
8.	x2		
9.	x2		
10.	x1		
11.	x2		
12.	Total Score		
13.	Per Mile Value		

6.	Existing Developed Sites and Intensive Use Areas				
		Distance Miles			
		0-2	2-6	6-12	12+
	Score	4	2	1	0
a.	Developed Sites				
b.	Intensive Use Areas				
	Subtotal Score				
	Subtotal Raw Score				

7.	Potential Sites and Areas	Distance Miles			
		0-2	2-6	6-12	12+
	Score	4	2	1	0
a.	B.O.R. Recognized Potential Composites				
b.	Recreation Inventory of Montana Statelands				
c.	Montana State Potential Areas				
d.	Montana State Long Range Recreation Improvement Program				
	Subtotal Score				
	Subtotal Raw Score				

8.	General Undeveloped Areas	Score			
		4	2	1	0
a.	Dispersed Recreation Value				
b.	Wildlife Values				
	Subtotal Score				
	Subtotal Raw Score				

9.	Accessibility	Score			
		4	2	1	0
a.	Level of Access				
b.	Land Ownership				
	Subtotal Score				
	Subtotal Raw Score				

10.	Conflicting Uses	Score			
		-4	-2	-1	0
a.	Water Quality Class C				
b.	Water Quality Class E				
c.	Conflicting Land Use				
d.	Air Quality Class				
	Subtotal Score				
	Subtotal Raw Score				

11.	Proximity Factors	Score			
a.	Proximity to Other Developed Sites	4	2	1	0
b.	Proximity to Other Public or Trust Lands				
c.	Proximity to Major Marshes, Streams Lakes, or Rivers				
d.	Proximity to Specially Managed Areas (Wilderness, Primitive Areas, etc.)				
e.	Proximity to Population Centers				
	Subtotal Score				
	Subtotal Raw Score				

EXPLANATION FOR THE RECREATION SUITABILITY EVALUATION FORM

Recreation Suitability Ratings

Using the attached recreation suitability evaluation form, the recreation suitability rating was prepared as follows:

1. Selection of the Recreation Land Unit - Recreation land units were chosen from the U.S. Forest Service mapping units, as mapped at a scale of 1:500,000.

   It was the assumed that land areas with similar characteristics would manifest similar recreation use patterns and similar recreational opportunities, especially with reference to dispersed recreation use. The validity of this approach is reinforced by the recreational experience unit mapping process outlined in the Recreation Opportunity Inventory and Evaluation report issued by the Northern Region of the U.S. Forest Service, June, 1974.

2. Recording the Segment and Subunit Number - The segment recorded here was taken from Figure V-1 for Step 2 analysis and Figure VI-1 for Step 3 analysis. The segment subunit numbers simply identify and record the location of each recreation land unit encountered by each corridor "link."

3. Segment Length and Subunit Length - Self-explanatory.

4. General Comments - This space on the form was used to record the Forest Service mapping units encompassed by each recreation land unit and to describe the geographic location of each of the recreation land units.

5. Evaluator and Date - Self-explanatory.

6. Recording Existing Developed Sites and Intensive Use Areas - Recorded under this item were all of the recreation sites and areas

identified in the Montana State-Wide Outdoor Recreation Plan prepared by the State of Montana Fish and Game Commission (MDFG) and submitted to the Federal Bureau of Outdoor Recreation (BOR) in 1973.

All of these sites and areas were taken from the above plan and plotted at a scale of 1:500,000 on a mylar overlay. Each of the sites or areas located within 0 to 2 miles of the proposed corridor was given a score of 4 which represents a high resource value. Each site within 6 miles of a proposed corridor was given a score of 2 (medium value), and each site within 6 to 12 miles was given a 1 (low value). All sites located beyond twelve miles were considered to be outside of the impact area and were given a "zero" value.

The "kind" of recreation site or use area was not differentiated; for instance, a campground and dude ranch would be valued the same if they were in the same distance zone. Please note that although this scoring appears to be the same as that used in the determinant evaluation process, the scoring system shown here relates only to the recreation resource values and not to the determination of impacts discussed in Chapter VII.

7. Potential Sites and Areas - Recorded under this item are the sites and areas identified by ongoing state and Federal recreation inventories. The ones used in this study are:

   a. The Recreation Composite proposed by the U.S. Forest Service and submitted to the BOR as special recreation areas to receive funding under the Land and Water Conservation Fund Act. These areas were plotted on a 1:500,000 overlay.

      Recreation of these study areas is essential because BOR's directives consider overhead utility lines a "major detraction from the natural quality of many outdoor recreation areas." Participants in the BOR programs are expected "to take all reasonable steps to bury, screen, or relocate existing overhead lines and to put all new electric wires less than 15-kV and telephone lines underground. The existence of all overhead lines must be documented in the project application, and the participant must indicate what measures are required to mitigate such environmental intrusions, and if the participant feels that the overhead line should not be removed, rerouted or buried, it must be indicated in the application submitted to BOR.

b. The Recreation Inventory of Montana State Lands was an "on-site" evaluation program by the Montana Department of State Lands to identify those state lands which possess unique characteristics within the categories of water, vegetation, topography, complementary off-site factors and scenery. The evaluation also gave special recognition to historical evidence and evidence of actual recreation use. This inventory represents six field seasons of work, in a continuing program funded jointly by the Montana Department of State Lands and BOR. Each of the sites inventoried within the study area were plotted on a 1:500,000 overlay.

c. The Montana Potential Recreation Areas represent mapping work done by the Montana Fish and Game Department and used by Montana Department of Natural Resources and Conservation, Energy Planning Division, in the preparation of the state's Draft EIS on the Colstrip in November of 1974. Each of these areas were plotted on a 1:750,000 (approx.) map by the DNRC EIS staff.

d. The Montana Long-Range Building Program Project Request Project Priority Table represents Montana's priorities for an expenditure of some 8.6 million dollars of state funds for 1978 biannual recreation developments. This proposed program aided in pin-pointing key areas programmed for development in the near future. All of these areas were mapped on a 1:500,000 overlay. Each potential site or area within 2 miles of a corridor alternative was given a score of 4 (high value), those within 2 to 6 miles were given a score of 2 (moderate value), and those within 6 to 12 miles were given a score of 1 (low value). Any sites or areas beyond 12 miles from the corridor were given a "zero" value.

8. Evaluating General Undeveloped Areas - Montanans generally prefer to recreate at "natural undeveloped environment areas such as undeveloped national forest areas, back country areas, and (on) any public land areas where there are a minimum of recreation facilities, or no facilities at all, but where recreation opportunities are abundant." A balanced impact assessment, therefore, should not single-out developed sites alone but must address the opportunities for the more dispersed types of recreation opportunities.

   a. In response to this, the Colstrip Recreation Suitability Analysis emphasized Dispersed Recreation Values, which were also determined from the Forest Service mapping units (from the land suitability pattern study for electrical transmission lines by the Northern Region of the U.S. Forest Service). These land mapping units provided the basis for scoring dispersed recreation. For example, an M-10 mapping unit, which is described as "an alpine and subalpine high forest area with glacial peaks, cirque headwalls, basins, and upper valley trough walls--sloping with vegetation that ranges from high subalpine forests of white bark pine, spruce, and subalpine fir to wet alpine meadows--where primitive type recreation" is the primary land use, was scored as a 4 (high value). A "plains" mapping unit such as P-13, which has "gently rolling--prairie hills formed by wind deposited silt--with principally bunchgrass with minor areas of ponderosa pine or douglas fir and a primary land use of dryland farming and grazing" was rated 1 (low value) for dispersed recreation.

   b. Measuring effect of Wildlife Values on Recreation Resources: The opportunity to hear, observe, photograph, and hunt Montana's wildlife is a significant dispersed recreation activity. Because wildlife impact values had already been inventoried in another data item, they were not rated here. Because of the nationwide emphasis on dispersed values by the U.S. Forest Service and the high values placed by Montana residents (MDFG 1973), this factor was given a double weight (2).

9. Accessibility

a. The Level of access for relative volumes of traffic on highways, roads, or trail systems, normally is an essential consideration in comparing recreation sites. The review, however, shows that Montana's road system is fairly extensive. Apparently, considerable penetration by off-road vehicles has occurred in the past few years, making an inventory impossible in the amount of time available.

It was also recognized that even if only the major known road systems were used, an overwhelming number of high impact areas would result, making the recognition of other important recreational values difficult. The Montana transportation network was not rated here but was directly overlayed to finalize the recreation determinant.

Public input also suggests that Montanans would prefer to place new transmission lines along established corridors rather than in the undeveloped backcountry area.

b. Land Ownership - The accessibility or availability of land for recreation is often largely dependent upon whether that land is in public or private ownership. Generally speaking, public lands have a high degree of accessibility and private lands have a very low degree of accessibility for recreation opportunities and activities.

Along with other dispersed recreation values, the accessibility factor was given a double weight (2) value.

10. Conflicting Uses - The extent to which recreation lands have been committed to other land uses or have been degraded by air or water

pollution, or subjected to excessive noise is also an important measure of recreation suitability.

a. Water Class C: Waters classified as "C" have the third highest standards within the state system. They are intended "to be maintained suitable for bathing, swimming and recreation; growth and propagation (or marginal propagation) of salmonid fishes and associated acquatic life, waterfowl and furbearers . . ." (MDHES 1974).

b. Water Class E: Waters classified as "E" have the lowest standards within the state system. They are intended "to be maintained for agricultural and industrial water uses other than food processing" (MDHES 1974).

c. Conflicting Land Uses: Types of land use such as heavy industry, large electric transmission facilities, substations, heavy logging operations, etc. substantially rule out or reduce recreation values.

d. Air Quality Class: Montana has some areas that are significantly affected by air pollution. The major problem areas are Missoula, Anaconda, and Butts. Recreation values for those areas were lowered accordingly.

Values for conflicting land use factors were expressed in terms of minus values (-4, -2, and -1). The resultant score was subtracted before making the final rating for each recreation land use.

11. Proximity Factors - The location of recreation sites and areas with respect to complementary off-site recreation resource values such as wilderness, rivers, streams, high quality fishing, etc., directly affects the value of the recreation land unit. The five proximity factors selected for this Colstrip Suitability Analysis were: 1) proximity to other developed sites; 2) proximity to other public or trust lands; 3) proximity to major water bodies; 4) proximity to

specially managed areas such as wilderness, primitive areas, etc.; and 5) proximity to population centers. Additional factors might have been used but, again, other data items such as archaeological history and wildlife values were already considered elsewhere in this study.

Because proximity or location factors bear significantly on recreation values, they were also given a double weight (X 2).

12. The final land use recreation value (score) was obtained by adding the final unweighted scores to the scoring table on the front side of the form and multiplying by the multiplier numbers assigned to each factor; the products were totaled to give the final score.

APPENDIX D-2

VISUAL RESOURCE DATA ITEMS: INFORMATION DEVELOPMENT AND MAPPING PROCEDURES

This appendix summarizes information in the Colstrip to Hot Springs Visual Resource Analysis prepared by Wirth Associates for this project (1977). Visual resource impacts were based on Management Classes and Contrast Ratings. This appendix explains how information was developed and mapped for each of these.

Visual Resource Management Classes

Visual Management units were identified through the following process:

1. Defining and mapping scenic quality classes;

2. Determining the visual sensitivity of land uses;

3. Mapping viewed areas and distance zones; and

4. Assigning and mapping Management Classes, based on the above information.

1. Defining and Mapping Scenic Quality Classes - The following procedures, based on USDA Forest Service 1974:12-16, were used:

    a. Landscape character types and subtypes were identified using maps in the USDA Forest Service publication Land Suitability for Electric Transmission Lines (1976b).

    b. For each character subtype identified, criteria were developed for assigning scenic quality classes (see Table D-2.1). These serve to describe the physical attributes of the landscape, and consider agriculture, urbanization and clearcutting.

Appendix A-4

VISUAL RESOURCE DATA ITEMS: INFORMATION DEVELOPMENT AND MAPPING PROCEDURES

This appendix summarizes information in the Colstrip to Hot Springs Visual Resource Analysis prepared by Wirth Associates for this project (1977). Visual resource impacts were based on Management Classes and Contrast Ratings. This appendix explains how information was developed and mapped for each of these.

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1. Defining and Mapping Scenic Quality Classes - The following procedures, based on USDA Forest Service 1974:12-15, were used:

    a. Landscape character types and subtypes were identified using maps in the USDA Forest Service publication Land Suitability for Electric Transmission lines (1976a);

    b. For each character subtype identified, criteria were developed for assigning scenic quality classes (see Table A-4-1). These criteria describe the physical attributes of the landscape, and consider agriculture, urbanization and clearcutting.

Table A-4-1 - SCENIC QUALITY INVENTORY

LANDSCAPE CHARACTER SUBTYPE	SCENIC QUALITY CLASS	DESCRIPTION
ALLUVIAL LANDS	CLASS A+	Examples of pristine, unique or outstanding landscapes.
	CLASS A	Continuous wide bands or zones of diverse riparian vegetation patterns along perennial rivers with meandering channel, braided streams, oxbows and lakes.
	CLASS B+	Based on intrusions or uniqueness.
	CLASS B	Narrow bands or ribbons of riparian vegetation including variation in mature trees and shrubs. Perennial streams with common meandering and flow characteristics.
	CLASS B-	Based on intrusions.
	CLASS C	Absent of riparian vegetation - grassland only lacking contrast, intermittent streams or small perennial streams with little or no fluctuation in flow, falls, rapids or meandering.
	CLASS C-	Intrusions are so extensive that scenic qualities for the most part are nullified.
INTERMOUNTAIN BASINS	CLASS A+	Examples of pristine, unique or outstanding landscapes.
	CLASS A	Intermountain basin with diverse coniferous and riparian vegetation, lakes, oxbows patterns, large meandering river or braided streams. Surrounding mountains.
	CLASS B+	Based on intrusions or uniqueness.
	CLASS B	Glacial drift and outwash terraces supporting lake bottom coniferous vegetation, common alluvial lands, and surrounding mountains of common interest which provide some spatial enclosure. Lakes and streams from 5 to 50 acreas with irregular shorelines.
	CLASS B-	Based on intrusions.
	CLASS C	Alluvial fans and terraces with native short grass prairie and sagebrush. Lacking in vegetative diversity and water features. Surrounding mountains of minimal to common interest providing little spatial enclosure.
	CLASS C-	Intrusions are so extensive that scenic qualities for the most part are nullified.
FOOTHILLS	CLASS A+	Examples of pristine unique or outstanding landscapes.
	CLASS A	When combined with distinctive mountains and intermountain basins, foothills may become of distinct interest.
	CLASS B+	Based on uniqueness or intrusions.
	CLASS B	Hogback ridges, rock outcropping and plateaus with diverse vegetation. Steep slopes, perennial drainages.
	CLASS B-	Based on intrusions.
	CLASS C	Gentle sloping to steep rounded topography with grassland vegetation and intermittent or minor perennial streams.
	CLASS C-	Intrusions are so extensive that scenic qualities for the most part are nullified.
MOUNTAINS	CLASS A+	Examples of pristine, unique or outstanding landscapes.
	CLASS A	Peaks, cirques, trough walls, alpine ridges, very steep fault escarpments (Mission Range, Bitteroot Range). Extensive areas of rock outcrop and tallus. Glacial lakes, stream headwaters, water falls. Alpine and subalpine forest and meadow. Distinctive scenic quality providing spatial enclosures. Land forms of moderate relief with rock outcrop found in the eastern plains (Little Wolf Mountains).
	CLASS B+	Based on intrusions and uniqueness.
	CLASS B	Angular lower elevation slopes, U-shaped glacial valleys, parallel ridge and valley, fault escarpments, very steep broken slopes, outcrops, river breakland. Subalpine forest, mixed coniferous forests grassland parks.
	CLASS B-	Based on intrusions.
	CLASS C	Landforms are steep broken valley slopes, plateau ridges, steep smooth slopes, low relief rounded slopes, rolling to hilly. Mixed coniferous forests and grassland parks.
	CLASS C-	Intrusions are so extensive that scenic qualities for the most part are nullified.
PLAINS	CLASS A+	Examples of pristine, unique or outstanding landscapes.
	CLASS A	Highly dissected plains benchland with narrow flat-topped ridges, buttes or mesas rimrocks and outcrops with complex vegetation patterns of ponderosa pine and shortgrass prairie. Permanent drainage patterns.
	CLASS B+	Based on intrusions and uniqueness.
	CLASS B	Dissected plains and steep benches, rims, breaks, outcrops. Short and tall grass prairie, mixed coniferous forest, small pothole lakes.
	CLASS B-	Based on intrusions.
	CLASS C	Broad level to rolling plains land and benches with shortgrass prairie vegetation. Mixed with scattered coniferous intermittent streams.
	CLASS C-	Intrusions are so extensive that scenic qualities for the most part are nullified.

The three-class Forest Service system (A,B,C) was expanded to seven classes (A+, A, B+, B, B-, C, C-) to permit finer distinctions; and

c. Preliminary mapping of scenic quality units was done using plastic topographic relief maps and ERTS imagery at 1:250,000 scale. Refinements were then made based on aerial observation during three flights over each corridor. The result of this process is the Scenic Quality map, Figure III-25.

2. Determining the Visual Sensitivity of Land Uses - A list of potentially sensitive land uses was developed and, based on information about preferences of Montana residents presented in the Montana Statewide Outdoor Recreation Plan (MDFG 1973) and FS and BLM guidelines, levels of sensitivity were assigned, as shown in Table A-4-2. The most highly sensitive land uses were labeled "Special Areas" and include Roadless Areas, Wilderness and Primitive Areas, and Proposed Wilderness. Land uses dependent on natural settings, high volume travel routes, and urban and suburban areas were assigned to the next most sensitive category, Level One. Areas of dispersed use (i.e., State Forests, BLM and National Forest lands, Wildlife Management Areas and Commerical Air Routes) were considered to be of Level Two sensitivity.

3. Mapping Viewed Areas and Distance Zones - Use areas and travel routes identified as sensitive in the previous step were mapped using a variety of sources, including:

   a. USGS National Topographic Maps 1:250,000 Scale Series;

   b. Montana Department of Highways Planning and Research Bureau. 1976. Montana Federal Aid Systems - Interstate, Primary, Secondary (1 inch = 10 miles);

Table A-4-2 - VISUAL SENSITIVITY

LAND USE	SPECIAL AREAS	SENSITIVITY LEVELS		
		1	2	3
TRAVEL ROUTES				
Interstate		*		
Primary		*		
Secondary		*		
Scenic Highways		*		
National Trails		*		
Historic Trails		*		
Air Routes (Commercial)			*	
Amtrack Railroad		*		
USE AREAS				
Urban		*		
Suburban		*		
National Wildlife Refuge		*		
State Parks		*		
Wildlife Management Area		*		
National Forest			*	
BLM			*	
Roadless Area	*			
Natural Area		*		
Wilderness and Primitive Area	*			
Grizzly Habitat		*		
Proposed Wilderness	*			
State Forest			*	
Campground				
National Forest		*		
State Forest		*		
Local		*		
Private		*		
Vista		*		
Roadside Rest		*		
Ski Area		*		
Cultural Resources				
National		*		
State		*		
Local		*		
Historic District		*		
Potential Wildlife Viewing		*		
Agriculture [1]		*	*	*
WATER				
Potential Wild and Scenic River		*		
Recreational Waterways		*		
Lakes (associated with recreational features)		*		

---

[1] Depends on extent and patterning of agriculture.

c. Montana Dept. of Fish and Game, Parks and Recreation Division (1973) Montana Statewide Outdoor Recreation Plan, Vol. 1, Executive Summary;

d. Montana Dept. of Fish and Game, Parks and Recreation Division (1973) Montana Statewide Outdoor Recreation Plan, Vol. 2, An Information Base;

e. Montana Water Resources Board (Undated) An Atlas of Water Resources in Montana By Hydrologic Basins, Inventory Series Report No. 11; and

f. Montana Dept. of Fish and Game, Classification of Montana Fishing Streams.

Plastic topographic relief maps (1:250,000) were then used to map the areas that could be seen from each mapped land use or road. Where appropriate, these viewsheds were then classified into one of three zones:

a. Foreground/Middleground - The area visible from the use area up to 5 miles away, where detail of management activities would be viewable;

b. Background - The area visible beyond the foreground/middleground, between 5 and 15 miles away from the use area or travel route; or

c. Seldom Seen - All areas not identified in the above two zones, generally areas more than 15 miles from the use area or travel route.

The resulting map, Visual Sensitivity, appears as Figure III-26.

4. Assigning and Mapping Management Classes - The Scenic Quality Classes and Visual Sensitivity maps were overlayed, and, using the

Table A-4-3 - VISUAL RESOURCE MANAGEMENT CLASS ASSIGNMENT MATRIX

	SENSITIVITY						
	Special Areas	Level One			Level Two		Level Three
SCENIC QUALITY		FG/MG	BG	SS	FG/MG	BG	
A+,A	P	R	R	R	PR	PR	PR
B+	P	R	PR	PR	PR	PR	M
B	P	PR	PR	PR	PR	M	MM
B-	P	PR	PR	PR	PR	M	MM
C,C-	P	PR	PR	M	M	MM	MM

FG/MG- Foreground/Middleground BG- Background SS- Seldom Seen

Management Classes Key:

P - Preservation

R - Retention

PR - Partial Retention

M - Modification

MM - Maximum Modification

1/ - Adapted from National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System, USDA Handbook No. 462, 1974, p. 43.

matrix in Table A-4-3, Visual Resource Management Classes were assigned. As an example, all areas of A quality scenery in the foreground/middleground of a Level One land use were assigned to the Retention Management Class.

As the final step in the mapping of management classes, contiguous areas of the same Management Class were combined. The resulting map, Visual Resource Management Classes, appears as Figure V-5.

Visual Contrast Rating

Developing contrast ratings involved five processes:

1. Rating contrasts for landforms;
2. Rating contrasts for vegetation;
3. Rating contrasts for structures;
4. Summing contrast scores for individual features; and
5. Defining and mapping high, medium, and low overall contrast categories.

1. Rating Contrasts for Landforms - Using maps in Land Suitability Pattern for Electric Transmission Lines (USDA Forest Service 1976a), six landforms were identified and mapped. Strengths of contrasts in form, line, color, and texture for each landform were predicted based on:

   a. the potential for skylining;

   b. slope effects on both visibility and extent of scarring;

   c. soil and rock color contrasts; and

   d. erosion potential.

These predicted contrast strengths were multiplied by element weight values, and these scores summed to provide total scores for each landform type, as shown on Table A-4-4.

2. Rating Contrasts for Vegetation - The Step 1 composite map of vegetative cover (Figure IV-5) was used to identify areas of agriculture, range, and forested areas where the climate is 1) cool and moist to cold and moderately dry, 2) moderately warm and dry to moderately cool and moist, 3) warm and dry, 4) warm and very dry and 5) varied. These mapping units are defined in Chapter IV. For the Visual Contrast Rating, forests with either varied or warm and very dry climates were both assumed to be low density forests. Forests in warm and dry climates were assumed to have moderate density and moderately warm and dry to moderately cool and moist forested areas were assumed to be high density forests. Contrast strengths were then assigned based on the following considerations:

> Changes in contrast are generally greatest in dense, even aged forest stands with little species diversity. Since these stands exhibit little contrast in landscape elements, disturbance would add contrast in line, form, texture, and color. High density forest areas were considered the highest in terms of vegetative contrast. The clear cutting of a 300' right-of-way in montane forest would represent a permanent scar for the life of the project. Vegetation change in form, line, color, and texture would be strong.
>
> Medium density forest clearing would result in moderate contrast in all four elements due to the more open patterning and diversity of species. Low density forest was considered weak in terms of potential contrast due to the open patterning of eastern Ponderosa pine and Lodgepole pine vegetation in these forests. Less clearing would be necessary, reducing the linear nature of the transmission right-of-way.
>
> Both rangeland and agriculture were considered a relatively low contrast due to the almost complete lack of vegetative disturbance. The most serious contrast

Table A-4-4 - CONTRAST RATING-LANDFORM

LAND SURFACE	ELEMENT	NO.		CONTRAST			SCORE
Flat Plains	Form	4	X	None	0	=	0
	Line	3	X	None	0	=	0
	Color	2	X	Moderate	2	=	4
	Texture	1	X	None	0	=	0
					Total		4
Rolling Plains	Form	4	X	Weak	1	=	4
	Line	3	X	Weak	1	=	3
	Color	2	X	Moderate	2	=	4
	Texture	1	X	Weak	1	=	1
					Total		12
Breaklands	Form	4	X	Moderate	2	=	8
	Line	3	X	Weak	1	=	3
	Color	2	X	Weak	1	=	2
	Texture	1	X	Weak	1	=	1
					Total		14
Foothills	Form	4	X	Moderate	2	=	8
	Line	3	X	Moderate	2	=	6
	Color	2	X	Moderate	2	=	4
	Texture	1	X	Moderate	2	=	2
					Total		20
Intermountain Basin 1) (Light Soil)	Form	4	X	Weak	1	=	4
	Line	3	X	Weak	1	=	3
	Color	2	X	Strong	3	=	6
	Texture	1	X	Weak	1	=	1
					Total		14
Mountain Basin	Form	4	X	Weak	1	=	4
	Line	3	X	Weak	1	=	3
	Color	2	X	Weak	1	=	2
	Texture	1	X	Weak	1	=	1
					Total		10
Mountain Soils 2) (Soil Problems)	Form	4	X	Strong	3	=	12
	Line	3	X	Strong	3	=	9
	Color	2	X	Strong	3	=	6
	Texture	1	X	Strong	3	=	3
					Total		30
Mountains	Form	4	X	Strong	3	=	12
	Line	3	X	Strong	3	=	9
	Color	2	X	Moderate	2	=	4
	Texture	1	X	Moderate	2	=	2
					Total		27

---

1) The following Intermountain Basin mapping unit was weighted for strong color contrast due to light colored soils: BI NFS 1976.

2) The following Mountain mapping units were weighted for strong color and texture contrast due to erosion, road cut slumping potential and light soils: M6, M8, M17, M18, M20, M22, M24, NFS 1976.

Table A-4-5 - CONTRAST RATING - VEGETATION

VEGETATION	ELEMENT	NO.		CONTRAST		SCORE
Agriculture	Form	4	X	None	0 =	0
	Line	3	X	None	0 =	0
	Color	2	X	None	0 =	0
	Texture	1	X	Weak	1 =	1
					Total	1
Range	Form	4	X	Weak	1 =	4
	Line	3	X	Weak	1 =	3
	Color	2	X	Moderate	2 =	4
	Texture	1	X	Weak	1 =	1
					Total	12
Low Density Forest	Form	4	X	Weak	1 =	4
	Line	3	X	Weak	1 =	3
	Color	2	X	Weak	1 =	2
	Texture	1	X	Weak	1 =	1
					Total	10
Medium Density Forest	Form	4	X	Moderate	2 =	8
	Line	3	X	Moderate	2 =	6
	Color	2	X	Moderate	2 =	4
	Texture	1	X	Moderate	2 =	2
					Total	20
High Density Forest	Form	4	X	Strong	3 =	12
	Line	3	X	Strong	3 =	9
	Color	2	X	Strong	3 =	6
	Texture	1	X	Strong	3 =	3
					Total	30

> would be associated with road cuts in rangeland where a moderate level of potential soil contrast would occur (Wirth 1977).

Table A-4-5 provides the results of the Vegetation Contrast Rating.

3. Structures - The contrast rating for structures deviates from the normal BLM rating method; the rating was a synthesis of sensitivity levels and the Visual Absorption Capability (VAC) of the landscape.

VAC is a Forest Service tool for assessing the ability of landscapes to visually absorb changes; it is based on the interaction of landform and vegetative landscape characteristics as shown in Table A-4-6.[1/] Mapping of landscape units was based on the same source information used to develop Landform and Vegetative Contrast Ratings.

Ratings for Visual Absorption Capability and Visual Sensitivity were then placed on different matrix axes in order to assign Structure Contrast scores, as shown in Table A-4-7.

> The concept of the structure contrast matrix is that the most visually sensitive areas [special areas, and foreground-middleground (Level One) areas] in a low VAC landscape would result in the greatest structure contrast. As VAC increases, and sensitivity levels decrease, structure contrast decreases. This analysis technique is intended to take into account the sensitivity of the viewer and the visibility of the proposed transmission facility in the landscapes associated with alternative Colstrip to Hot Springs routes.
>
> The process of establishing these structure contrast levels involved overlaying the VAC map and visual sensitivity map to establish common areas of structure contrast (Wirth 1977).

[1/] General information on VAC can be found in the USDA Forest Service Draft on Visual Absorption Capability, 1976; detailed information on the development of VAC for this analysis can be found in the Colstrip to Hotsprings Visual Resource Analysis, Wirth Assoc., 1977.

Table A-4-6 - VISUAL ABSORPTION CAPABILITY

	VEGETATION TYPES				
CHARACTERISTIC LANDSCAPE UNITS	AGRICULTURE	RANGE	LOW DENSITY FOREST	MEDIUM DENSITY FOREST	HIGH DENSITY FOREST
INTERMOUNTAIN BASINS (Light soils)	H	I	I+	I	I-
INTERMOUNTAIN BASINS	H	I+	H	I	I-
FLAT PLAINS	I+	I-	I	NA	NA
ROLLING PLAINS	H	I+	H	I+	NA
BREAKLANDS	I+	I	I+	I	NA
FOOTHILLS	I+	I	H	I-	L
MOUNTAINS (SOIL PROBLEMS)	NA	I -	I	I-	L
MOUNTAINS	I+	I+	I+	I-	L

LEGEND:

HIGH = H
INTERMEDIATE - HIGH = I+
INTERMEDIATE = I
INTERMEDIATE - LOW = I-
LOW = L

Table A-4-7 - CONTRAST RATING - STRUCTURES

	SENSITIVITY LEVELS					
VISUAL ABSORPTION CAPABILITY	SPECIAL AREAS	FG-MG1	FG-MG2	BG1	BG2	SELDOM SEEN LEVEL 3
HIGH	30	10	5	1	0	0
INTERMEDIATE - HIGH	30	15	10	5	1	0
INTERMEDIATE	30	20	15	10	5	1
INTERMEDIATE - LOW	30	25	20	15	10	5
LOW	30	30	25	20	15	10

LEGEND

WEAK = 1-10
MODERATE = 11-20
STRONG = 21-30

4. Summing Feature Scores - Each mile of potential corridor was then examined and scored for each contrast type. The scores were then added together to give an overall Contrast Rating. For example, using the values on Tables A-4-4, A-4-5, and A-4-7, an area in mountains, having soil problems, low density forest, and a low VAC in a Level One background would receive scores of 30, 10, and 20 for landforms, vegetation, and structures contrasts, respectively, for an overall contrast score of 60.

5. Defining and Mapping High, Moderate, and Low Contrast Ratings - Total contrast scores between 90 - 61 were considered high; 60-31, moderate; and 30-1, low.

   The results of this process are shown in Figure V-6, the Visual Contrast Rating map.

SEGMENT AND LINK COMPARISONS FOR VISUAL RESOURCES
(STEP 3)

Tables S-5-1 and VII-28 display the information used to make the following comparisons. Table VII-28 gives complete visual information by individual corridors, and Table S-5-1 gives the same information by the links compared below. As explained in Chapter VII, visual sensitivity and scenic quality combine to create the Visual Management Classes, and the management classes and contrast together determine visual impacts; thus, there are no directly obvious numerical relationships between the visual impacts and other columns. Rather, the tables are presented to give the reader an impression of which concerns (sensitivity, quality, contrast) are most important for any link.

The term "Visual Data Item Score", as used in the following corridor comparisons, refers to the sum of the miles of high, moderate, and low visual impact multiplied by the appropriate data item value and determinant weight for each (as discussed in Chapter IV under "Methodology"). The Score/Miles column reflects Data Item Score divided by the number of link miles.

1. Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
D_1+D_4	74.8	523	7.0	17%	0%
Q	88.7	621	7.0		0%

These alternatives have the same per mile visual impact scores; as a result, the shorter option, D_1+D_4, would create the fewest visual impacts.

2. Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
D_1+J	164.8	1120	6.8	5%	7%
D_1+Q	160.8	1181	7.3		

Appendix A-5

SEGMENT AND LINK COMPARISONS FOR VISUAL RESOURCES
(STEP 3)

Tables A-5-1 and VII-24 display the information used to make the following comparisons. Table VII-24 gives complete visual information by individual corridors, and Table A-5-1 gives the same information by the links compared below. As explained in Chapter VII, visual sensitivity and scenic quality combine to create the Visual Management Classes, and the management classes and contrast together determine visual impacts; thus, there are no directly obvious numerical relationships between the visual impacts and other columns. Rather, the tables are presented to give the reader an impression of which concerns (sensitivity, quality, contrast) are most important for any link.

The term "Visual Data Item Score", as used in the following corridor comparisons, refers to the sum of the miles of high, moderate, and low visual impact multiplied by the appropriate data item value and determinant weight for each (as discussed in Chapter IV under "Methodology"). The Score/Miles column reflects Data Item Score divided by the number of link miles.

1.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
D_3+D_2	74.9	523	7.0	17%	0%
Q	90.7	633	7.0		0%

These alternatives have the same per mile visual impact scores; as a result, the shorter option, D_3+D_2, would create the fewest visual impacts.

2.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
D_1+2	166.4	1126	6.8	5%	7%
C_1+0	164.2	1191	7.3		

Table A-5-1 - VISUAL RESOURCE SEGMENT AND LINK COMPARISONS (Step 3)

		SENSITIVITY					SCENIC QUALITY							MANAGEMENT CLASSES				CONTRAST			VISUAL IMPACTS		
SEGMENT	TOTAL MILES	SPECIAL AREA	FOREGROUND/MIDDLEGROUND/ LEVEL ONE	BACKGROUND LEVEL ONE	FOREGROUND/MIDDLEGROUND LEVEL TWO	LEVEL THREE	A+	A	B+	B	B-	C	C-	PRESERVATION	RETENTION	PARTIAL RETENTION	MAXIMUM MODIFICATION	HIGH	MODERATE	LOW	HIGH	MODERATE	LOW
1. D_3+D_2	74.9	0	51.6	13.3	10.0	0	0	0	17.9	37.0	5.4	14.6	0	0	18.1	56.8	0	14.6	55.6	4.7	19.0	43.4	12.5
Q	90.7	0	76.1	7.5	7.1	0	0	4.7	11.4	30.3	0	29.3	15.0	0	15.0	75.7	0	6.2	79.3	5.2	17.7	67.3	5.7
2. D_1+D_2	166.4	0	122.1	40.8	3.5	0	0	16.8	8.0	50.2	39.8	51.6	0	0	31.0	135.4	0	16.1	137.9	12.4	30.5	118.5	17.4
C_1+O	164.2	2.1	89.0	65.0	8.1	0	0	20.1	64.2	39.8	8.5	31.6	0	2.4	48.8	112.6	0	16.0	129.5	18.7	40.2	112.0	12.0
3. C_4+E_1	28.4	0	20.0	1.7	6.7	0	0	0	0	16.0	0	12.4	0	0	0	28.4	0	11.5	15.1	1.8	15.4	10.0	3.0
N	32.2	0	32.2	0	0	0	0	.6	0	2.2	5.8	23.6	0	0	0	32.2	0	6.1	13.4	12.7	24.4	26.0	13.1
4. E_1+E_2+P	43.1	0	24.2	12.4	6.5	0	11.0	0	3.3	28.8	0	0	0	0	8.9	34.2	0	15.5	27.6	0	14.9	28.2	0
F	42.7	0	31.7	11.0	0	0	0	17.1	0	16.6	5.1	3.9	0	6.7	9.9	24.1	2.0	9.0	32.3	1.4	18.1	22.4	2.2
5. S	6.0	0	3.0	3.0	0	0	0	1.5	4.5	0	0	0	0	0	2.0	4.0	0	0	6.0	0	2.0	4.0	0
C_2	7.0	0	2.7	4.3	0	0	3.5	0	3.5	0	0	0	0	0	5.0	2.0	0	0	7.0	0	5.0	2.0	0
6. M_2	9.3	3.3	2.3	0	3.7	0	0	4.4	0	0	4.9	0	0	3.8	5.5	0	0	6.0	3.3	0	9.3	0	0
R	8.3	0	0	0	8.3	0	0	.8	3.5	4.0	0	0	0	3.2	5.1	0	0	8.3	0	0	8.3	0	0
7. $O+D_3+D_4$	79.9	0	53.8	19.6	6.5	0	0	3.9	30.0	36.4	5.4	4.2	0	0	26.8	53.1	0	11.1	64.1	4.7	28.0	48.7	3.2
$S+C_3+$ C_4+E_1+ E_2+P	82.4	0	55.2	17.1	10.1	0	11.0	1.5	7.8	36.5	0	25.6	0	0	14.1	68.3	0	20.6	60.0	1.8	32.2	47.2	3.0
8. $O+D_3+$ D_4+I+ $J+K$	181.5	0	136.4	38.6	6.5	0	0	5.9	45.4	98.5	20.1	11.6	0	0	52.3	129.2	0	21.1	138.4	22.0	40.3	135.7	5.5
$S+C_3+$ C_4+E_1+ E_2+E_3+G	169.6	0	124.3	25.8	19.5	0	17.8	86.8	7.4	32.0	0	25.6	0	0	92.4	77.2	0	51.0	83.5	35.1	88.3	77.0	4.4
9. $G+E_3$	110.8	0	80.3	21.1	9.4	0	6.8	85.3	2.9	15.8	0	0	0	0	80.7	30.1	0	30.4	47.1	33.3	57.5	52.0	1.3
$K+J+$ $I+P$	125.2	0	93.8	31.4	0	0	0	2.0	18.7	82.4	14.7	7.4	0	0	24.7	100.5	0	7.4	97.9	19.9	13.7	109.2	2.3

Use of D_1+D_2 would create the lesser visual impact. Visual impacts would be 5 percent lower overall and 7 percent lower per mile. The differences between these links are due to impacts along segments 0 and D_2; visual impact scores for segments C_1 and D_1 are similar (see Table A-5-1), though the impacts would have different causes. Most high visual impacts on D_1 would result from crossing mountains, whereas impacts along C_1 would result from crossing plains of higher quality than those crossed by D_1. The different visual impacts along segments C_1 and 0 are primarily due to their different easterly approaches to Boulder. Segment 0 approaches Boulder from the southern end of the Elkhorns, whereas segment D_2 approaches from the foothills well south of the Elkhorns and then drops into the Boulder Valley, where contrast and quality are lower. Even though D_2 is within a view of Highway 15, visual impacts would be somewhat less than for segment 0 (see Table A-5-1). Use of segment 0 would result in increased probability of skylining and corridor clearings. Segment 0 would also cross 19.4 miles of land rated B+ and higher, compared to only 3.4 miles on D_2, but only 17.5 miles of the corridor would be prominent in view from sensitive areas, compared to 22.8 miles for D_2.

3. Link	Miles	Visual Data Item Scores	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
C_4+E_1	28.4	254	8.9		
N	32.2	191	5.9	25%	34%

Contrary to team impact results, the visual analysis identifies N as the least impact of these two corridors, because it has 25 percent lower overall score and a 34 percent lower per mile score. All land along both segments was assigned to the Partial Retention Management Class, though for different reasons. Generally, link N covers highly sensitive, minimal scenic quality land. The E_1C_4 link covers both highly sensitive, minimally scenic lands (along Highway 12) and less sensitive, but higher quality lands. Because all these combinations fall into the Partial Retention Management Class, contrast becomes the crucial factor in determining relative visual impacts along these links. Contrasts south of Helena (on E_1C_4) are often high because of corridor contrasts in forested areas and skylining on hill and ridgetops. Contrasts on the north side of the Helena Valley, however, are low because corridors would be indistinguishable, and due to haze, towers tend to be visible for shorter distances than one would expect. Thus, the visual analysis shows N to have the least potential contrast, and, in this case, the least visual impact route.

4. Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
E_1+E_2+P	43.1	348	8.1	3%	4%
F	42.7	358	8.4		

Of these alternatives for crossing the Continental Divide, E_1+E_2+P (the crossing at Mullan Pass), would have 3 percent less visual impact overall and 4 percent less per mile than F (the crossing at MacDonald Pass). Although transmission lines at Mullan Pass would create higher contrasts, the lines would cross sensitive viewsheds less frequently and would have fewer viewers than would the heavily used MacDonald Pass. Using Mullan Pass would also avoid crossings of a highway, a scenic portion of Spotted Dog Creek, and greater amounts of restrictive visual Management Classes found on the MacDonald Pass alternative. Using the Mullan Pass alternative would, however, sacrifice an area viewed by dispersed recreators.

5. Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
S	6.0	48	8.0	33%	22%
C_2	7.0	72	10.0		

From a visual resources standpoint, S would have the least impact of these alternatives, having a 33 percent lower overall impact and 22 percent lower per mile. C_2 would have a greater impact because it is longer and crosses highly scenic portions of the Limestone Hills.

6.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
M_2	9.3	112	12.0		
R	8.3	100	12.1	11%	1%

M_2 and R were both rated high due to total length, so the shorter of the two, R, would appear to have the lower potential visual impact. Link R crosses a ridge, however, which is the focal point of the valley to the north. Thus, considerable effort would be required to minimize the high visibility of the corridor.

7.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
$O+D_3+D_4$	79.9	638	8.0	1%	
$S+C_3+C_4$ $+E_1+E_2+P$	82.4	647	7.9		1%

The visual impact scores do not identify a clear preference between these two links: the analysis shows OD_3D_4, the southern link, would have a 1 percent higher overall impact, whereas the northern link (S-P) has a 1 percent lower per mile score. The southern link, however, appears preferable: both links cross high quality lands where transmission lines would be highly noticeable and within view of sensitive users, but the southern link, by not passing near a major city, would be viewed by fewer people and thus would avoid the problems around Helena.

High visual impacts on the OD_3D_4 link would be concentrated in the gulches south of Helena and in the mountains on both sides of the Continental Divide. High visual impact scores in the gulches south of Helena would result mostly from high contrasts expected in this hilly, forested landscape. Transmission lines here would span gulches and be skylined on ridges, degrading the scenic potential. For about 10 miles on each side of the Continental Divide, this link passes through distinctively scenic areas in which transmission lines would be highly visible.

Much of this area is also in the foreground of sensitive users, primarily recreationists.

High visual impacts on the southern link would be concentrated between the crossing of the Elkhorns and the crossing of the Continental Divide.

8.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
$O+D_3+D_4+I+J+K$	181.5	1296	7.1	14%	20%
$S+C_3+C_4+E_1+E_2+E_3+G$	169.6	1503	8.9		

These links involve the portion of the Applicant's proposed corridor west of Townsend ($SC_3C_4E_1E_2E_3G$) and an alternative generated to avoid the Helena area (OD_3D_4IJK). The visual analysis shows that the latter would have 14 percent less overall impact and 20 percent less per mile and 52 miles respectively for the alternative corridor. The Applicant's

and 52 miles respectively for the alternative corridor. The Applicant's
and 52 miles respectively for the alternative corridor. The Applicant's

proposed corridor crosses 88 miles that would receive high visual impacts (i.e., large areas south of the Mission Range, south of the Seeley-Swan Valley, north of the Garnets, the crossing of the Continental Divide and crossing the gulches south of Helena). The alternate link, by comparison, crosses only 40 miles that would receive high visual impacts (i.e., the crossing of the Elkhorns, the Boulder area, and the crossing of the Continental Divide). (See Figure VII-14.)

9.

Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
$G+E_3$	110.8	1006	9.1		
K+J+I+P	125.2	808	6.5	20%	29%

These two links are alternate possibilities for approaching Hot Springs from west of Helena. K+J+I+P is clearly the preferable choice from a visual resources standpoint, having 20 percent less overall impact and 29 percent less impact per mile. On only 7 miles of KJIP would contrasts be high and only 25 miles of the link crosses the Retention Visual Management Class land, compared to more than 30 and 80 miles, respectively, for link GE_3. The management class ratings are based on sensitivity and quality ratings: KJIP parallels Interstate 90 for much of its length whereas GE_3 crosses recreation areas dependent on natural settings, meaning that both cross several miles of land rated high for sensitivity (KJIP-80 Miles, GE_3-94 miles). However, KJIP crosses only 2 miles of A and A+ rated landscapes, whereas GE_3 crosses more than 90 miles.

10.	Link	Miles	Visual Data Item Score	Score/Miles	Least Impact Choice (% Less) Total	Least Impact Choice (% Less) Per Mile
	PIJKL	141.3	890	6.3	30%	29%
	$E_3HJM_1RM_3$	141.9	1273	9.0		

The Helena (Avon Valley) link would create 30 percent less visual impact overall and 29 percent less per mile. If passing through Helena is necessary, the Helena (Avon Valley) corridor is clearly the preferable option.

Appendix A-B

COMMON AND SCIENTIFIC NAMES FOR SELECTED MONTANA PLANTS AND ANIMALS

COMMON NAME	SCIENTIFIC NAME
Plants	
Bearded wheatgrass	*Agropyron subsecundum*
Bent	*Agrostis* spp.
Big sagebrush	*Artemisia tridentata*
Blue grama	*Bouteloua gracilis*
Bluegrass	*Poa* spp.
Buffalo grass	*Buchloe dactyloides*
Canada thistle	*Cirsium arvense*
Cheatgrass brome	*Bromus tectorum*
Common snowberry	*Symphoricarpos albus*
Cottonwood	*Populus* spp.
Dalmatian toad flax	*Linaria dalmatica*
Dogwood	*Cornus stolonifera*
Douglas fir	*Pseudotsuga menziesii*
Engelmann spruce	*Picea engelmannii*
Field bindweed	*Convolvulus arvensis*
Fringed sagewort	*Artemisia frigida*
Grouse whortleberry	*Vaccinium scoparium*
Idaho fescue/bluebunch wheatgrass	*Agropyron spicatum*
Leafy spurge	*Euphorbia esula*
Limber pine	*Pinus flexilis*
Little blue stem	*Schizachyrium scoparium*
Lodgepole pine	*Pinus contorta*
Mountain mahogany	*Cercocarpus montanus*
Needle and thread	*Stipa comata*
Needlegrass	*Stipa* spp.
Needleleaf sedge	*Carex stenophylla*
Pine reedgrass	*Calamagrostis rubescens*
Ponderosa pine	*Pinus ponderosa*
Prairie junegrass	*Koeleria cristata*
Prairie sandreed	*Calamovilfa longifolia*
Quaking aspen	*Populus tremuloides*
Rocky Mountain juniper	*Juniperus scopulorum*
Rose	*Rosa* spp.
Rough fescue	*Festuca scabrella*
Russian knapweed	*Centaurea repens*
Russian thistle	*Salsola kali*
Sandberg bluegrass	*Poa secunda*
Sedges	*Carex* spp.
Sheep fescue	*Festuca ovina* var. *brevifolia*
Silver sage	*Artemisia cana*
Skunkbush sumac	*Rhus trilobata*
Snowberry	*Symphoricarpos* spp.
Subalpine fir	*Abies lasiocarpa*
Subalpine larch	*Larix lyallii*

Appendix A-6

COMMON AND SCIENTIFIC NAMES FOR SELECTED MONTANA PLANTS AND ANIMALS

COMMON NAME	SCIENTIFIC NAME
Plants	
Bearded wheatgrass	Agropyron subsecundum
Bent	Agrostis spp.
Big sagebrush	Artenisia tridentata
Blue grama	Bouteloua gracilis
Bluegrass	Poa spp.
Buffalo grass	Oryzopsus hymenoides
Canada thistle	Cirsium arvense
Cheatgrass brome	Bromus tectorum
Common snowberry	Symphoricarpos albus
Cottonwood	Populus spp.
Dalmatian toad flax	Linana dalmatica
Dogwood	Cornus stolinifera
Douglas-fir	Pseudotsuga menziessii
Engelmann spruce	Picia engelmannii
Field bindweed	Convolvulus arvensis
Fringed sagewart	Artemesia frigida
Grouse whortleberry	Vaccinium scoparium
Idaho fescue-bluebunch wheatgrass	Agropyron spicatum
Leafy spurge	Euphorbia esula
Limber pine	Pinus flexilis
Little blue stem	Schizachyrium scoparium
Lodgepole pine	Pinus contorta
Mountain mahogany	Cercocarpus montanus
Needle and thread	Stipa comata
Needlegrass	Stipa viridula
Needleleaf sedge	Carex eleocharis
Pine reedgrass	Calamagrostis rubiscens
Ponderosa pine	Pinus ponderosa
Prairie junegrass	Koeleria cristata
Prairie sandreed	Calamovilfa longifolia
Quaking aspen	Populus tremuloides
Rocky Mountain juniper	Juniperus scopulorum
Rose	Rosa spp.
Rough fescue	Festuca scabrella
Russian knapweed	Centauria repens
Russian thistle	Salsola kali
Sandburg bluegrass	Poa secunda
Sedges	Carex spp.
Sheep fescue	Festuca ovina var. Brevifolia
Silver sage	Artemisia cana
Skunkbrush sumac	Rhur trilobata
Snowberry	Symphoricarpos spp.
Subalpine fir	Abies lasiocarpa
Subalpine larch	Larix lyallii

Timothy	*Phleum* spp.
Threadleaf sedge	*Carex filifolia*
Western chokeberry	*Prunus virginiana*
Western larch	*Larix occidentalis*
Western wheat grass	*Agropyron smithii*
Whitebark pine	*Pinus albicaulis*
Willow	*Salix* spp.

Mammals

American pronghorn	*Antilocapra americanus*
Bats	
Big-eared bat	*Plecotus townsendii*
California bat	*Myotis californicus*
Fringed bat	*Myotis thysanodes*
Long-legged bat	*Myotis volans*
Spotted bat	*Endura maculatum*
Beaver	*Castor canadensis*
Black bear	*Ursus americanus*
Black-footed ferret	*Mustela nigripes*
Black-tailed jackrabbit	*Lepus californicus*
Black-tailed prairie dog	*Cynomis ludovicianus*
Bighorn sheep	*Ovis canadensis*
Bison	*Bison bison*
Bobcat	*Lynx rufus*
Canada lynx	*Lynx canadensis*
Cougar	*Felis concolor*
Coyote	*Canis latrans*
Elk	*Cervus canadensis*
Fisher	*Martes pennanti*
Great basin pocket mouse	*Perognathus parvus*
Grizzly bear	*Ursus arctos horribilis*
Hispid pocket mouse	*Perognathus hispidus*
Hoary marmot	*Marmota caligata*
Lynx	*Lynx canadensis*
Marten	*Martes americana*
Meadow jumping mouse	*Zapus hudsonicus*
Mink	*Mustela vison*
Moose	*Alces alces*
Mountain goat	*Oreamnos americanus*
Mule deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethicus*
Northern bog lemming	*Synaptomis borealis*
Pigmy rabbit	*Sylvilagus idahoensis*
River otter	*Lutra canadensis*
Shrews	
Dwarf shrew	*Sorex nanus*
Merriam's shrew	*Sorex merriami*
Preble's shrew	*Sorex preblei*
Pygmy shrew	*Microsorex hoyi*
Striped skunk	*Mephitis mephitis*
Spotted skunk	*Spilogale putoris*
Swift fox	*Vulpes velox*
Uinta chipmunk	*Eutamias umbrinus*

Uinta ground squirrel	*Spermophilus armatus*
Weasels	
Least weasel	*Mustela nivalis*
Long-tailed weasel	*Mustela frenata*
Short-tailed weasel	*Mustela erminea*
White-tailed deer	*Odocoileus virginianus*
White-tailed prairie dog	*Cynomis leucurus*
Wolf	*Canis lupus irremotus*
Wolverine	*Gulo luscus*
Woodland caribou	*Rangifer tarandus*

Birds

American golden plover	*Pluvialis dominica*
American wigeon	*Mareca americana*
Barrow's goldeneye	*Bucephala islandica*
Blue grouse	*Dendragapus obscurus*
Black brant	*Branta canadensis*
Black duck	*Anas rubripes*
Black-necked stilt	*Himantopus mexicanus*
Blue-winged teal	*Anas discors*
Buffalohead	*Bucephala albeola*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Chukar partridge	*Alectoris graeca*
Cinnamon teal	*Anas crecca*
Common goldeneye	*Bucephala clangula*
Common merganser	*Mergus Merganser*
Common teal	*Anas crecca*
Dunlin	*Erolia alpina*
Eagles, falcons, hawks	Falconiformes
Bald eagle	*Haliaeetus leucocephalus*
Cooper's hawk	*Accipiter cooperii*
Ferruginous hawk	*Buteo regalis*
Golden eagle	*Aquila chrysaetos*
Goshawk	*Accipiter gentilis*
Grayfalcon	*Falco rusticolus*
Marsh hawk	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Pigeon hawk	*Falco columbarus*
Prairie falcon	*Falco mexicanus*
Sharp-shinned hawk	*Accipiter striatus*
European wigeon	*Mareca penelope*
Gadwall	*Anas stepera*
Greater scaup	*Aythya marila*
Green-wing teal	*Anas carolinensis*
Harlequin duck	*Histrionicus histrionicus*
Hooded merganser	*Lophodytes cucullatus*
Hungarian partridge	*Perdix perdix*
Lesser scaup	*Aythya affinis*
Mallard	*Anas platyrhynchus*
Merlin	*Falco columbarius*
Merriam's turkey	*Meleagris gallopava merriami*
Northern shoveler	*Spatu clypeata*

Oldsquaw	Clangula hyemalis
Owls	Strigiformes
Barred owl	Strix varia
Boreal owl	Aegolius funereus
Burrowing owl	Speotyto cunicularia
Great grey owl	Strix nebulosa
Long-eared owl	Asio otus
Pygmy owl	Glaucidium gnoma
Saw-whet owl	Aegolius acadicus
Screech owl	Otus asio
Snowy owl	Nyctea scandiaca
Pintail	Anas acuta
Red-breasted merganser	Mergus serrator
Redhead	Aythya americana
Red knot	Calidris canutus
Ring-necked duck	Aythya collaris
Ring-necked pheasant	Phasianus colchicus
Ross goose	Chen rosii
Ruddy duck	Oxyura jamaicensis
Ruddy turnstone	Arenaris melanocephala
Ruffed grouse	Bonasa umbellus
Sage grouse	Centrocercus urophasianus
Sanderling	Crocethia alba
Semipalmated sandpiper	Ereunetes pusillus
Sharp-tailed grouse	Pediocetes phasianellus
Shorebirds	Charadriformes
Mountain plover	Eupoda montana
Piping plover	Charadrius melodus
Short-billed dowitcher	Limnodromus griseus
Songbirds	Passeriformes
Eastern bluebird	Sialia sialis
Dickcissel	Spiza americana
Western bluebird	Sialia mexicanus
Spruce grouse	Canachitis canadensis
Surf scoter	Melanitta perspicillata
Turkey	Meleagris gallopavo
Trumpeter swan	Olor buccinator
Waterfowl	Anseriformes
Snow goose	Chen hyperborea
Whistling swan	Olor columbianus
Western sandpiper	Ereunetes mauri
White-fronted goose	Anser albifrons
White-tailed ptarmigan	Lagopus leucurus
White-winged scoter	Melanitta perspicillata
Whooping crane	Grus americana
Wood duck	Aix spansa
Woodpeckers	Piciformes
Black-backed three-toed woodpecker	Picoides arcticus
Northern three-toed woodpecker	Picoides tridactylus
Williamson's sapsucker woodpecker	Sphyrapicus thyroideus

Fish

Artic grayling	Thymallus arcticus
Brook trout	Salvelinus frontinalis

Brown trout	*Salmo trutta*
Cutthroat trout	*Salmo clarki*
Dolly Varden trout	*Salvelinus malina*
Kokanee salmon	*Oncorhynchus nerka kennerlyri*
Mountain whitefish	*Prosopium williamsoni*
Rainbow trout	*Salmo gairdneri*

Reptiles

Milk snake	*Lampropeltis triangulum*
Plains hognose snake	*Heterodon nasicus*
Snapping turtle	*Chelydra serpentina*
Spiny softshell	*Trionyx spiniferus*

Amphibians

Bullfrog	*Rana catesbiana*
Couerd'Alene salamander	*Plethodon vandykei*
Dakota toad	*Bufo hemiophrys*
Pacific giant salamander	*Dicampton ensatus*
Spotted chorus frog	*Pseudacris clarki*
Tailed frog	*Ascaphuis truei*
Wood Frog	*Rana sylvatica*

Appendix E

TER PUBLIC INVOLVEMENT

Background

TER preparation included development of a Public Involvement and Information Plan (PIIP). The objectives of this plan were: (1) to keep the public informed of the study and its progress; (2) to identify public concerns about corridors; (3) to provide opportunities for public involvement in corridor evaluations; and (4) to coordinate PIIP public involvement activities and all related programs.

Public Response

Numerous public comments were received via comment cards, letters, and petitions. All available data on public concern at the time of project assignment was acquired during the development of the Westinghouse Report (WESCO/ATA 1975) and the State of Montana EIS (DNRC/DEIS 1974). To update this data, a brochure about the TER project was sent to people listed on a combined USFS, BLM, BIA, and BPA mailing list. A news release issued at the same time pointed out the availability of this brochure for those not on the mailing list and requested public comments. Approximately 1,500 brochures were sent and about 150 were returned. Public comments and concerns were available to use in establishing the numerical analogs for impact weighting prior to specific segment analysis. Using this rationale and the information on public concerns allowed the emphasis on the various impacts to be consistent throughout the study area. Table E-1 lists the concerns identified through public response. Concerns most frequently identified are summarized below.

1. The proposed transmission lines should parallel existing utility corridors. Transmission line concentration was preferred for several reasons. First, the scenic quality of Montana would be degraded by additional transmission line corridors. Second, building next to an existing transmission line would not subject new areas to environmental damage. Third, paralleling existing lines would avoid recreation, wilderness, and wildlife areas.

Appendix B

TER PUBLIC INVOLVEMENT

Background

TER preparation included development of a Public Involvement and Information Plan (PIIP). The objectives of this plan were: (1) to keep the public informed of the study and its progress; (2) to identify public concerns about corridors; (3) to provide opportunities for public involvement in corridor evaluations; and (4) to coordinate PIIP public involvement activities and all related programs.

Public Response

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1. The proposed transmission lines should parallel existing utility corridors. Transmission line concentration was preferred for several reasons. First, the scenic quality of Montana would be degraded by additional transmission line corridors. Second, building next to an existing transmission line would not subject new areas to environmental damage. Third, paralleling existing lines would avoid recreation, wilderness, and wildlife areas.

2. The State of Montana should not have to pay more, in either environmental or economic terms, than the parts of Pacific Northwest where the power would be used. Coal should be shipped via railroads, rather than coal energy shipped via transmission lines.
3. The project should be completed immediately. The energy is needed very soon. Additional delays could cause economic hardships either by forcing brown-outs or by increased construction costs that would be passed to the rate payers.
4. High voltage transmission lines are hazardous to human safety and health.
5. Energy conservation should be forced and power supplies to industry reduced.

Table B-1 - SUMMARY OF IDENTIFIED PUBLIC CONCERNS

Types of Comments	Letters	Petitions/ Signatures	Comment Cards
Against Project			18
In Favor of Project			25
Complete Project Immediately			11
Ship Coal Not Electrical Power	1	32	10
Parallel Existing Utilities to Minimize Impacts	1	202	25
Concerned About Electrical Hazards	1		7
Force Energy Conservation			6
Develop Alternative Energy Sources			5
Do Not Cross Farmland			2
Keep the Power for Montana			4
Plan Corridor for Future Lines			2
Concerned About Archeological Resources			2
Need More Private Owner Input	2		1
Do Not Cross Federal Land			1
Cross Federal Land Only			1
Do Not Parallel Highways			1
Bury Transmission Lines			2
Concerned About Geologic Stability	1		
Resent Outside Environmentalists Slowing Project			2
Concerned About Land Values			1
Montana Should Not Be Impacted More Than States Using the Power		32	6
Mentioned Route Preference			5

Public Meetings

Public meetings were held throughout the study area during the State of Montana EIS process (DNRC/DEIS 1974). The draft report noted where public meetings would be held along with the need and request for public involvement. The results of this comprehensive request for comments were analyzed and included in the final State EIS (DNRC/FEIS 1975) for consideration in the State's decisionmaking process.

The Public Involvement and Information Plan developed as a part of the Colstrip Work Management Plan included the provision for public meetings or other methods of keeping the public informed on the project. Public involvement was to be initiated as determined necessary by the Colstrip Transmission Steering Committee and the EIS Project Manager. Due to critical timing on the scheduled release of the Draft Federal Colstrip EIS and completion of the TER, it was determined that the formal public involvement will be a part of the overall Federal EIS process. As the TER is the principle source document on transmission and corridor analysis for use by the contractor in preparation of the Federal Colstrip EIS, the public will have an opportunity to comment and express concerns at that time. The TER will be made available for public review at libraries throughout the study area as well as at the offices of the participating Federal agencies.

Appendix C

GLOSSARY OF TECHNICAL TERMS

ABSOLUTE AREAS - Definable areas within the planning region where it is environmentally or technically infeasible or otherwise prohibited due to management or legal constraints to locate or construct a transmission line.

ALIGNMENT - The specific, proposed route of a transmission line.

ALLUVIAL FAN - A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan, deposited by a stream at the place where it issues from a narrow canyon or valley onto a plain or valley.

ALLUVIUM - Clay, silt, sand, and gravel or other rock material transported and eventually deposited by flowing water.

ALTERNATIVE (or ALTERNATE) CORRIDORS - Corridors either evaluated by the State of Montana and Montana Power or identified where there are objections by land management agencies to the "proposed" corridor.

AMBIENT AIR QUALITY - The normal or average prevailing quality of the surrounding air in a given area in terms of the type and amounts of various air pollutants found.

ANIMAL UNIT MONTH (AUM) - The amount of feed or forage required by one animal unit (AU) for 1 month. An AU is one mature (1000 lb.) cow or the equivalent, based on an average daily forage consumption of 26 pounds of dry matter per day.

BACKGROUND - The portion of the seen area which lies beyond the foreground/middleground, usually the area between 5 and 15 miles from the observer site or road. More generally, the distant part of a landscape; surroundings, especially those behind something and providing harmony or contrast.

BIOMASS - The total quantity at a given time of living organisms of one or more species per unit of space (species biomass), or of all the species in a community (community biomass).

BORALFS - The forested soils of cool climates which have more clay in the subsoil than in the surface layer; these soils have water available to plants for at least 3 months of the growing season.

BOROLLS - Fertile soils of cool climates with a grass vegetation having a very dark colored surface layer.

BRAKING RESISTOR - A resistor connected to a generator bus or a nearby bus to slow a generator which is accelerating due to a fault or other abnormal condition.

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BRAKING RESISTER - A resistor connected to a generator bus or a nearby bus to slow a generator which is accelerating due to a fault or other abnormal condition.

CALCAREOUS - Consisting of or containing calcium carbonate; growing on limestone or in soil impregnated with lime.

CAPACITORS - Two conducting materials separated by insulating material, with the capability of storing electrical energy for a period of time.

CENOZOIC AGE - An era of geologic history that extends from the beginning of the Tertiary period to the present time and is marked by a rapid evolution of mammals and birds and of grasses, shrubs, and higher flowering plants.

CHARACTERISTIC LANDSCAPE - The established landscape within an area being viewed. This does not necessarily mean a naturalistic character. It could refer to a farming community, an urban landscape, or a primarily natural environment.

CIRCUIT BREAKER - A device used to close or open an electrical circuit, especially one carrying high current and high voltage.

COLSTRIP EIS MANAGER - The official designated by the lead agency as having responsibility for completion of the Colstrip EIS within the requirements established by the Department.

CONDUCTOR - A material, usually in the form of a wire or cable, suitable for carrying an electric current.

CONDUCTOR CONFIGURATIONS - Single conductor: one conductor used per phase. Bundled conductor: two or more conductors per phase. Bundles with up to eight conductors may be used on future BPA lines.

CONTERMINOUS - Having, or being enclosed within, a common boundary.

CONTINENTAL CLIMATES - Are characteristics of the interior of land masses. They are marked by large annual, daily, and day-to-day ranges of temperature, low relative humidity, and (generally) by moderate or small and irregular rainfall.

CONTRAST - The effect of a striking difference in the form, line, color, or texture of an area being viewed. More generally, the juxtaposition of dissimilar parts.

CONTRAST RATING - A method of determining the extent of visual impact for any existing or proposed activity that will modify any landscape feature.

CORONA - Corona is a discharge which occurs when the voltage applied to a conductor exceeds the dielectric strength of the surrounding insulation. In all cases, corona activity causes power loss. On a transmission line, corona appears when the applied potential ionizes the air. Sharp edges, points, abrasions, etc., which are caused by many factors including mishandling of conductors before and during installation, can precipitate corona. Corona causes radio and TV interference and, if intense, produces sufficient quantities of ozone to be detected by smell. It can be seen in bluish tufts or streamers surrounding the conductor, and generally a hissing sound can be heard.

Where the installation is solid, such as in a transformer, corona is destructive and results in a dielectric failure of the insulation.

CORRIDOR - A broad path, identified during transmission line planning and environmental analysis, within which routes can be located. For this study, corridors are 2 miles in width.

CORRIDOR STUDY ZONES - Zones outside of the vicinity of State of Montana corridors required for the evaluation and definition of additional corridors.

COUNTERPOISE - A buried wire system connected to the footings of transmission line towers or poles used to establish a low resistance path to earth, usually for lightning protection.

DIELECTRIC - Insulating material, such as air or glass, which permits passage of the lines of force of electric fields but has a high resistance to the conductance of current; a nonconductor.

DISCLIMAX COMMUNITY - An enduring climax community (the kind of community capable of prepetuation under the prevailing climatic conditions) altered by disturbance by man or domesticated livestock, e.g., a grassland which has displaced a deciduous forest.

DISTANCE ZONES - Divisions of an area seen from travel routes or use areas based on the distance from those roads or areas. These zones are foreground/middleground, background, and seldom seen areas.

EASEMENT - The right or privelage obtained by BPA through negotiated contract or condemnation to construct, maintain, and operate transmission facilities within right-of-way.

ECOTONE - A transition area between two adjacent ecological communities usually exhibiting competition between organisms common to both.

ELECTRIC FIELD - The measure of the force exerted on a unit electrical charge at a point in space. The source of the electric fields around transmission lines are the charges on the high voltage conductors.

ELECTROMAGNETIC - Of or pertaining to the magnetic forces produced in a surrounding medium by the flow of current in a circuit.

ELECTROMAGNETIC INTERFERENCE (EMI) - The disruption of electromagnetic waves over the entire frequency spectrum from 10 Hz to 100 MHz EMI can directly or indriectly contribute to a degradation in performance of radios and television.

ELECTROSTATIC - Voltage phenomenon pertaining to stationary, electrically charged bodies.

EPICENTER - The part of the earth's surface directly above the focus of an earthquake.

EXTIRPATE - To destroy completely; exterminate.

EYRIES (also AERIES) - Nests or broods of birds of prey such as eagles or ravens.

FAULT - A fracture or zone of fractures in the earth along which movement has occurred.

FAULT SCARP - An escarpment or cliff resulting from a fault, or a dislocation of the adjacent rocks.

FIELD INTENSITY AND STRENGTH - The magnitude of an electric field; expressed in units of kV/m (kilo-volts per meter).

FLUVENTS - Non-sandy soils formed in water deposited sediments on floodplains of rivers or streams. Their development is frequently interrupted by new layers of sediment deposited during floods.

FOREGROUND/MIDDLEGROUND - The area visible from a travel route or use area to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants is no longer apparent in the landscape. Vegetation is apparent only in pattern or outline.

GAUSS (G) - Unit of magnetic induction, representing one line of force per square centimeter of area normal to the magnetic field. The magnitude of the earth's magnetic field is about 0.6 gauss.

GRID - In an electron tube, an electrode having one or more openings for the passage of electrons or ions and usually controlling the flow of the electrons or ions. Also, the name given to an interconnected system of electric transmission lines and associated equipment for the movement or transfer of electric energy in bulk between points of supply and points of demand.

GROUND - A conducting connection between an electric circuit and earth.

GROUND-RETURN SYSTEM - A power transmission system in which one of the conductors is replaced by ground.

HERTZ (Hz) - A unit of frequency equal to one cycle per second.

HYDRO GENERATION - A type of generation or power or energy output in which the prime mover is driven by water power.

INTERFERENCE - The disturbance of data transmission by stray or undesired electrical signals.

INONIZATION - A process by which electrons are detached from atoms or molecules, thus originating ions and free electrons. It occurs as a result of high energy radiation or by collisions.

INSULATOR - A device that is resistant to the conduction of electricity used for isolating and supporting conductors.

KILOVOLT (kV) - 1000 volts (a volt is a measure of electricity potential difference which will cause a current of one ampere to flow through a conductor with one ohm of resistance.

KILOVOLT PER METER - (kV/m) = 10^3 V/m. Metric unit of field strength used in association with field strengths at ground level under transmission lines.

LANDSCAPE CHARACTER SUBTYPE - A division of a major character type which is significantly different in visual characteristics from the other subtypes.

LANDSCAPE CHARACTER TYPE - Large physiographic area of land which has common characteristics of landforms, rock formations, water forms, and vegetative patterns.

LEAD AGENCY - The Federal agency designated at the Department level as having the responsibility for the preparation of an environmental statement for a project impacting several Federal agencies. In this case the lead agency has been designated to the Bonneville Power Administration.

LINE RELIABILITY - The ability to perform a required function under stated conditions for a stated period of time; the performance of the system under stress.

LINK - Combination of segments which connect two or more widely separated points.

LITHOSOL - Shallow soil consisting of imperfectly weathered rock fragments.

LOAD CENTER - The point at which electrical loads of a given area are assumed to be connected for purposes of analysis.

LOAD DROPPING - Disconnecting an electrical load from the power system.

LOAM - A soil consisting of a mixture of varying proportions of clay, silt, and sand.

MAGNETIC FIELD - The measure of the force acting on a unit magnetic pole at a point in space. The source of magnetic fields associated with transmission lines is the current flowing through the lines.

MARINE CLIMATES - Are under the predominant influence of the sea. They are found where prevailing winds blow onshore. They extend inland either until they meet a climatic divide or, in level country, until they become modified and gradually attain greater continentality. A marine climate is characterized by small diurnal and annual ranges of temperature.

MAXIMUM MODIFICATION MANAGEMENT CLASS - The least restrictive Visual Resource Management Class, in which management activities may dominate the characteristic landscape, but, when viewed from a distance, must appear natural.

MEGAWATTS (Mw) - 1000 kilovolts or one million watts (a watt is a unit of electrical power equal to 1/756th horsepower).

METALLIFEROUS - Yielding or containing metal.

MITIGATE - In environmental usage, the reduction or control of adverse environmental impact through various measures which seek to make the impact less severe, less obvious, more acceptable, etc.

MODIFICATION MANAGEMENT CLASS - A Visual Resource Management Class in which management activities and projects may visually dominate the characteristic landscape, but must appear to be a natural occurrence.

NOISE - Any unwanted extraneous electrical quantity or sound interfering with the proper reception of the information intended to be received.

OCHREPTS - Forested soils which have developed definite soil layers but which do not have more clay in the subsoil than in the surface layer.

ORTHENTS - Non-sandy soils whose development has been retarded by either cold climate, lack of moisture, or rapid erosion which carries the soils away before a distinct profile can develop.

ORTHIDS - Soils which are dry for long periods and have well developed soil layers.

OZONE (O_3) - A form of oxygen containing three atoms in the molecule. It is bluish gas, very active chemically, and a powerful oxidizing agent. It is formed when oxygen in the air is subjected to a silent electric discharge. It occurs in ordinary air in small amounts only. The photochemical reaction of hydrocarbons and nitric oxide can also produce ozone. Ozone can severely injure many forms of plant life.

PARTIAL RETENTION MANAGEMENT CLASS - A Visual Resource Management Class in which management activities and projects must remain visually subordinant to the characteristic landscape.

PHASE - Used in A.C. terminology. When two alternating currents (or voltages) are in phase, they reach their corresponding zero, maximum, and intermediate values at exactly the same instant. If they do not, they are said to be out of phase. The condition in which phase differences between electrical systems is at regular intervals and with a constant phase-angle is called polyphase. The alternating current used normally is three phase.

PLAN OF SERVICE - An electrical solution to transmission or electrical needs of a region. The plan of service can consist of several types of electrical facilities, including transmission lines, switching stations, substations, microwave communication facilities, etc.

PLANNING REGION - Geographically defined region which includes all feasible corridor locations for the electrically feasible plans of service being studied.

PODZOLIC - Soils developed in moist climates enriched with clay; especially under coniferous or mixed forest.

PRESERVATION MANAGEMENT CLASS - The most restrictive Visual Resource Management Class, where only natural ecological changes are acceptable.

"PROPOSED" CORRIDOR - The corridor approved by the State of Montana. Does not imply preference by Federal agencies, only proposal to the Federal agencies.

PSAMMENTS - Similar to fluvents and orthents except that psamments have a sandy texture.

QUATERNARY AGE - The latest geologic period of the Cenozoic era which began about one million years ago, at the time of extensive glaciation in North America.

RAINSHADOW - The area of diminished rainfall on the lee side of a mountain or mountain range, where the rainfall is noticeably less than on the windward side.

REFERENCE ROUTE - A feasible route within a delineated corridor utilized for making quantitative analyses for comparative purposes. (Reference route is not to be construed as final location.)

REINFORCEMENT - In the case of transmission line capacity, reconductoring a line with larger conductors and/or operating a line at a higher nominal voltage level.

REPEATER - A station in between terminals of a microwave system which receives a signal from a distant station, amplifies and retransmits the signal to another distant station. Most repeaters do this in both directions simultaneously.

RETENTION MANAGEMENT CLASS - A restrictive Visual Resource Management Class where only management activities or projects that are not visually evident are acceptable.

RIGHT-OF-WAY - A strip of land acquired or used by an electrical utility for its transmission lines.

SCENIC QUALITY - The existing variety and visual interest in a landscape. Seven distinctions (A+, A, B+, B, B-, C, C-) in scenic quality are made in this study. (See Table A-4-1).

SEEN AREA - Total area observed. May be measured in terms of foreground, middleground, and background.

SEGMENT - The simplest subdivision of a corridor with its length being defined by its intersection with other segments.

SELDOM SEEN - A distance zone within seen areas, these are the areas which can be seen from sensitive areas or routes and are more than 15 miles away.

SENSITIVITY LEVEL(S) - A measure of viewer interest in the scenic qualities of the landscape. Levels used in this report are: Special Areas, Level One, Level Two, and Level Three.

SERIES COMPENSATION - Capacitors connected in series with a transmission line to reduce the net inductive reactance of the line. Reducing the net inductive reactance of the line effectively shortens the line electrically.

SHEAVE, CONDUCTOR - A specially designed pulley used in stringing conductor. The sheave is attached to the insulator string and the conductor threaded through it.

SHUNT COMPENSATION - Inductors connected between a transmission line, or transformer tertiary winding, and ground to reduce the voltage rise resulting from capacitive line charging currents.

SINGLE POLE SWITCHING - Independent relaying and switching of each phase of a transmission line. This independent operation allows a fault on one phase to be cleared without taking the other two phases out of service.

SOCK LINE - A flexible line attached to the fore end of a conductor to expediate the stringing of the conductor on towers and poles.

SPACE DAMPER - Mechanical device attached to each subconductor of a conductor bundle to serve the dual purpose of damping vibrations and preventing physical contact of subconductors.

SPECIAL AREAS - As used in the visual analysis "Special Areas" category is the most sensitive of the Sensitivity Levels. "Special Areas" include Roadless, Wilderness, Primitive, and Proposed Wilderness Areas.

STABLE SYSTEM - A description of the dynamic operating conditions of a power system. A power system consists of several generators which are connected together and to a load by transmission lines. The amount of power that can be transferred from one machine to another following a disturbance is limited. When this limit is exceeded, the machines become unstable and may lose synchronism with each other. When this happens, relays operate to separate the generators not running in synchronization. Stability is, therefore, defined as that attribute of a system that enables it to develop restoring forces equal to or greater than the disturbing forces so as to maintain a state of equilibrium.

TERTIARY PERIOD - The first period of the Cenozoic era (the latest era of geologic time).

TRANSFORMER - A device usually used to transform electrical energy from one voltage level to another.

TRANSMISSION - In power system usage, the bulk transport of electricity from large generation centers over significant distances, at relatively high-voltages.

TRANSMISSION WORK MANAGEMENT PLAN - The comprehensive plan outlining the process and responsibilities to be followed in completing the Colstrip Transmission Environmental Report.

UNPERTURBED FIELD - An electric or magnetic field which has not been significantly distorted by the presence of some object or body.

VIEWED AREA - Seen area, viewshed.

VIEWSHED - Total area observable from an area or road, seen area.

VISUAL ABSORPTION CAPABILITY (VAC) - A USFS term for a method of estimating the relative ability of land to withstand manipulation without significantly affecting its visual character. It judges the relative capability of land to absorb visual change.

VISUAL RESOURCE MANAGEMENT CLASSES - Categories which define acceptable limits of the visibility of projects in the landscape. Lands of similar visual and aesthetic value, based on physical and sociological characteristics, are assigned to the same class. The classes are: Preservation, Retention, Partial Retention, Modification and Maximum Modification.

VISUAL SENSITIVITY - Viewer interest in the scenic qualities of the landscape.

VOLTAGE GRADIENT - Synonymous with electric field strength. The rate at which voltage increases or decreases along a conductor or through a dielectric such as air.

WATT - The electrical unit of power or rate of doing work. It is analogous to horsepower or footpounds per minute of mechanical power.

Appendix D

CONSULTATION AND COORDINATION WITH OTHERS

During both the corridor analysis process and the preparation of this document, a number of federal, state, and local agencies and organizations were contacted for information, as listed below.

Federal Agencies

- U.S. Department of Agriculture
  - ARS (Agricultural Research Service), Northern Plains Soil and Water Research Center, Sidney, Montana
  - ASCS (Agricultural Stabilization Conservation Service), Aerial Photography Field Office, Salt Lake City, Utah
  - Forest Service
    - Region One, Missoula, Montana
      - Deer Lodge National Forest
      - Gallatin National Forest
      - Helena National Forest
      - Lewis and Clark National Forest
      - Lolo National Forest
    - Region Six, Portland, Oregon
  - LACIE-ARS (Large Area Crop Inventory Experiment-Agricultural Research Service), NASA, Houston, Texas
  - Soil Conservation Service, Montana State Office, Bozeman

- U.S. Department of Energy
  - Bonneville Power Administration, Portland, Oregon

- U.S. Department of Interior
  - Bureau of Land Management, Portland, Oregon; Billings, Butte, and Lewiston, Montana; Denver, Colorado
  - Bureau of Indian Affairs, Billings, Montana
  - Bureau of Outdoor Recreation, Denver, Colorado
  - Bureau of Reclamation, Billings, Montana
  - Fish and Wildlife Service, Billings, Montana, Denver, Colorado
  - Geological Survey, Billings, Montana; Helena, Montana; Denver, Colorado
  - National Park Service, Denver, Colorado
  - Office of the Regional Solicitor, Portland, Oregon

- U.S. Department of the Army
  - Corps of Engineers, Omaha, Nebraska

- U.S. Environmental Protection Agency, Denver, Colorado

- U.S. Federal Highway Administration

- Intermountain Forest and Range Experiment Station, Northern Region, Forest Service Lab, Missoula, Montana; Ogden, Utah

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    Fish and Wildlife Service, Billings, Montana; Denver, Colorado
    Geological Survey, Billings, Montana; Helena, Montana; Denver, Colorado
    National Park Service, Denver, Colorado
    Office of the Regional Solicitor, Portland, Oregon

U.S. Department of the Army
    Corps of Engineers, Omaha, Nebraska

U.S. Environmental Protection Agency, Denver, Colorado

U.S. Federal Highway Administration

Intermountain Forest and Range Experiment Station, Northern Region, Forest Service Lab, Missoula, Montana; Ogden, Utah

State Agencies

State of Montana
    Board of Crime Control, Helena
    Bureau of Mines
    Department of Community Affairs
        Planning Division
        Research and Information System Division
    Department of Fish and Game
        Environmental and Information Division
        Recreation and Parks Division
    Department of Health and Environmental Sciences
        Air Quality Bureau
        Water Quality Bureau
    Department of Livestock
    Department of Natural Resources and Conservation
        Energy Planning Division
        Soil Science Division
    Department of Planning and Economic Development
        Information Systems Division
    Department of State Lands
        Division of Land Administration
    Historic Preservation Officer

Local Agencies

Montana
    Billings-Yellowstone County Planning Organization
    Bozeman City-County Planning Board
    Butte City-County Planning Board
    Broadwater County, Clerk Recorder
    Cascade County Planning Board
    City of Bozeman
        Water Department
    City of Helena
        Water Department
    Flathead Drainage-Areawide Planning Organization
    Great Falls City-County Planning Board
    Judith Basin County, Clerk Recorder
    Lake County Planning Board
    Madison County Commissioners
    Missoula County Planning Board
    Meagher County Planning Board
    Mid-Yellowstone - Areawide Planning Organization
    Montana Supreme Court, Management Information Systems
    Musselshell County Planning Board
    Office of Superintendent of Education
    Treasure County Planning Board
    Wheatland County, Clerk Recorder

Other

Anton Forest, Norfolk, Connecticut
Confederated Salish and Kootenai Tribe

Other (Continued)

Cornell University, Ithaca, New York
Cumin Associates, Billings, Montana
EROS Data Center
IBEW (International Brotherhood of Electric Workers) Local #532,
    Billings, Montana
Idaho Cooperative Wildlife Research Unit, Wolverine Study Project
Meisel Photochrome Corporation, Atlanta, Georgia
Montana Power Company
Montana State University, Bozeman
Nature Conservancy, Portland, Oregon
Oregon State University, Corvallis, Oregon
Statistical Reporting Service
University of Montana, Missoula
    Department of Geology
    Institute for Social Research
Westinghouse Electric Corporation

Appendix E

The Montana Board of Natural Resources and Conservation has approved the following set of construction guidelines for this project. They must be followed by the Applicant during construction and post-construction activities. Additional guidelines might be developed by Federal Land Managers for crossing Federal lands.

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COLSTRIP TRANSMISSION PROJECT
CONSTRUCTION GUIDELINES FOR 500 KV
COLSTRIP TO HOT SPRINGS TRANSMISSION LINES

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

December 30, 1977

DEFINITIONS

BOARD: Montana Board of Natural Resources and Conservation

DEPARTMENT: Montana Department of Natural Resources and Conservation

AUTHORIZED AGENT OF THE BOARD: The DEPARTMENT

OWNER: The Colstrip Project Management

ENGINEER: Charles T. Main, Inc. (authorized representative of the OWNER)

CONTRACTOR: Constructors of the Facility

NOTE: These guidelines have been prepared specifically for the proposed Colstrip to Hot Springs twin 500 kV Transmission Lines, and may not be strictly applicable to other lines. Additions or amendments to these guidelines shall be made only with approval of the BOARD.

0.0 GENERAL

Construction of the two 500 kV lines shall require good construction practices reflecting the landowners' needs, environmental impacts, economics, and engineering considerations. These guidelines for construction shall become part of the Contract with the successful bidder, and shall include the following: (1) general guidelines for CONTRACTOR performance; (2) planning and coordination; (3) construction camps or facilities; (4) public safety and protection of property; (5) access roads and vehicle movement; (6) right-of-way clearing and site preparation; (7) tower design, tower erection, and conductor stringing; (8) timing of construction; (9) fences and cattleguards; (10) grounding; (11) erosion and sediment control; (12) archaeology and history; (13) control of fires; (14) waste disposal; (15) herbicides; (16) post-construction cleanup and reclamation; and (17) post-construction activity.

The CONTRACTOR shall conduct his operations in a manner to protect the quality of the environment. These guidelines contain provisions which shall be considered in all the CONTRACTOR's operations. If the CONTRACTOR fails to operate within the intent of these guidelines, the BOARD or its authorized agent shall direct the OWNER or its authorized representative of changes to operating procedures. Continued violation shall result in a work suspension until correction or remedial action is taken by the CONTRACTOR.

The CONTRACTOR's specific responsibilities are described below.

1.0 GENERAL GUIDELINES FOR CONTRACTOR PERFORMANCE

1.1 The Construction Guidelines shall be part of the Contract documents; therefore, the CONTRACTOR shall be held responsible for adherence to the guidelines as part of the work. To assure compliance to the guidelines, the CONTRACTOR shall submit to the State of Montana a separate Performance Bond in the amount of $1,000 per circuit-mile of construction as listed in the "Scope of Work," pertaining specifically to the restoration of the right-of-way and adjacent lands which might have been damaged during the course of the work and are still in need of restoration upon completion of construction in the affected areas. The entire bond shall be held in escrow until post-construction monitoring by the DEPARTMENT indicates that all guidelines have been followed and revegetation is progressing satisfactorily, at which time the CONTRACTOR shall be released from the performance bond. At the time the CONTRACTOR is released, the OWNER shall submit to the State of Montana a Performance Bond in the amount of $200 per circuit mile of construction, to be held in escrow for five years, to ensure that reclamation and road closures have been effective where required.

1.2 The CONTRACTOR shall formally and informally brief all contractor supervisors and employees on environmental constraints prior to and during construction, and shall post such reminders on job sites.

1.3 All activities of the CONTRACTOR shall comply with the Environmental Criteria for Electric Transmission Systems issued by U.S. Departments of the Interior and Agriculture, and with all local, state, and federal environmental and sanitary requirements.

2.0 PLANNING AND COORDINATION

Prior planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts will be minimized. It also provides the only means by which the DEPARTMENT can adequately evaluate the proposed line and suggest further mitigation. It forces the CONTRACTOR to plan in advance the use of roads, timing of construction, and other details, and allows combination of roads and special use sites where possible. Prior planning by the CONTRACTOR shall include, but is not necessarily limited to, the following:

2.1 Prior to construction of any segment of the line, the locations of all construction access roads, maintenance access roads, poles, towers, conductors, staging sites, pulling sites, batch plant sites, splicing sites, borrow pits, waste disposal areas, campsites, and storage and housing facilities in the right-of-way shall be plotted on ortho photomosaics and/or plan and profile maps, at a scale of 1:24,000 or larger, or on available USGS 7.5' topographic maps (scale: 1:12,000), and submitted to the DEPARTMENT. Any of the above-mentioned sites which lie outside the right-of-way shall be plotted on maps or photomosaics at a scale of 1:250,000 or larger and submitted to the DEPARTMENT. All locations shall be submitted at least 30 days prior to the appropriate phase of line construction for each site.

2.2 The CONTRACTOR shall provide to the DEPARTMENT a list of subcontractors, estimated number of workers, inventory of available equipment, and a proposed time schedule at least 30 days prior to the beginning of construction for each segment of line. The DEPARTMENT is to be notified immediately of any significant changes or updates in this time schedule.

2.3 Maintenance and access roads shall be used jointly. Roads intended to be used as permanent maintenance roads should be initially designed as such.

2.4 Maintenance routes to all points on the line should be planned before construction ends.

2.5 All excavations for sand, gravel, clay, borrow or riprap materials may be subject to either the Open Cut Mining Act or Hard Rock Mining Act, and the CONTRACTOR shall apply for necessary permits at least 60 days in advance.

3.0 CONSTRUCTION FACILITIES

3.1 The preservation of the landscape and environment shall be a primary consideration in the location of temporary construction camps, storage areas, and buildings required in the performance of the work.

3.2 Construction sites shall be kept as small as possible and shall be located where most environmentally compatible, such as in areas having the flattest available slope and lacking fragile soil or vegetation types. Full restoration and reshaping of these areas including seeding and mulching shall be made following Section 16 of these Guidelines -- "Post-Construction Clean-up and Reclamation."

3.3 All work areas shall be maintained in a neat, clean, and sanitary condition at all times.

4.0 PUBLIC SAFETY AND PROTECTION OF PROPERTY

4.1 Construction operations shall not close or obstruct any portion of any railroad, public road, public trail, or other property until the necessary permits have been obtained from the authorities having jurisdiction. Copies of these permits shall be given to the Engineer.

4.2 Sensitive areas which have been identified by the DEPARTMENT before centerline approval and listed on plan and profile maps, and all cultivated and planted areas and vegetation such as trees, plants, shrubs, and grass on or adjacent to the right-of-way which do not interfere with the performance of work, shall be preserved.

4.3 Reasonable precautions shall be taken to protect, in place, all public land survey monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, they shall be re-established and referenced in accordance with the procedures outlined in the "Manual of of the right-of-way centerline should be near towers for the same reason.

5.7 Where practical, temporary roads shall be constructed on the levelest land available. Where roads cross flat land they shall not be graded or bladed unless necessary, but may be flagged to show their location.

5.8 Construction activities and travel shall be conducted to minimize dust as directed by the ENGINEER, the BOARD or the Authorized Agent of the BOARD. Water, straw, wood chips, dust pallative, gravel, combinations of these, or similar control measures may be used. Oil or similar petroleum-derivatives shall not be used.

6.0 RIGHT-OF-WAY CLEARING AND SITE PREPARATION

6.1 Clearing of survey lines shall be done using hand methods or small power tools only. During clearing of the right-of-way, shrubs shall be preserved to the greatest extent possible. Where shrub removal is necessary, brush blades and not dirt blades shall be used to minimize disturbance to roots.

6.2 Clearing of the right-of-way shall be limited to the cutting of trees which would interfere with conductor stringing or operation of the line over a ten-year period.

6.3 Scalping of the earth or any unnecessary disturbances shall not be allowed on any clearing, except in rocky areas, or on slopes where cuts and fills are necessary.

6.4 No timber shall be cut or destroyed outside the right-of-way without first obtaining permission from the appropriate landowner. The CONTRACTOR shall be held liable for any unauthorized cutting, injury or destruction to timber whether such timber is on or off the right-of-way. The extent of such liability shall be to reimburse the landowner for such timber at the current market value.

6.5 Cleared materials shall be cut as close to the ground as practicable, but not exceeding 6 inches above the ground. Stumps need not be removed unless they conflict with a structure or guy anchor.

6.6 Special logging techniques, hand clearing, or hand excavation may be required by the BOARD or its Authorized Agent in certain highly sensitive or fragile areas (such as mountain streams, scenic areas, highway crossings, and historical sites), as determined on a site-by-site basis before centerline approval.

6.7 Wherever appropriate, selective clearing shall be used to make curved, wavy, or irregular boundaries along the right-of-way limits. Where there is potential for long tunnel views of transmission lines or access roads, and where appropriate, special care shall be taken to screen the lines from view. This can be done by judicious use of screen planting. Where appropriate, special care shall be taken to leave a separating screen of vegetation where the right-of-way and highways and rivers are parallel (see USDI and USDA, "Environmental Criteria for Electric Transmission Systems.").

6.8 All earth-moving equipment shall be operated only by qualified, experienced personnel.

6.9 The CONTRACTOR's general foreman shall make sure that crane pads are constructed in accordance with accepted construction practices, and that only one crane pad is constructed per tower site. Construction of crane pads shall not be allowed on level ground except for extreme conditions (such as soft or marshy ground).

6.10 No motorized travel on, scarification of, or displacement of stabilized talus slopes shall be allowed except where absolutely necessary and where approved by the BOARD or its Authorized Agent.

6.11 The CONTRACTOR shall take reasonable measures to avoid the creation of noise levels that are safety or health hazards.

6.12 The DEPARTMENT, in its evaluation of the centerline, may designate certain areas along the right-of-way as environmentally sensitive. These areas are to be identified by the DEPARTMENT before centerline approval and include, but are not limited to, scenic, historical and archaeological areas, fish and wildlife refuges, water supply watersheds, and public recreational areas such as parks and monuments. The ENGINEER shall notify the CONTRACTOR to take all necessary actions to avoid adverse impacts of these sensitive areas.

7.0 TOWER DESIGN, TOWER ERECTION, AND CONDUCTOR STRINGING

7.1 Helicopters shall be used to string socklines, transport tower structures, and to erect towers where warranted on an economic or environmental basis. Areas requiring use of helicopters shall be identified by the DEPARTMENT prior to centerline approval.

7.2 At certain wetlands heavily used by migratory birds, certain measures may be required to reduce the incidence of wire strikes, as specified by the DEPARTMENT and approved by the BOARD prior to centerline approval. These changes may include but are not necessarily limited to use of self-supporting rather than guyed towers, local habitat modification, or installation of warning devices such as flags or balloons on static wires.

8.0 TIMING OF CONSTRUCTION

Construction and motorized travel may be restricted or prohibited at certain times of the year at critical sites which differ seasonally in sensitivity to construction-related disturbances. These sites shall be identified by the DEPARTMENT before centerline approval. They include sites:

a. in the vicinity of heavily used recreation sites on weekends or holidays;

b. on or near winter ranges or other areas important to moose, elk, deer, antelope, mountain sheep, and mountain goats during the appropriate months;

c. in the vicinity of rookeries, active grouse strutting and dancing grounds, or raptor nests during spring and summer;

d. in or near streams during seasons of migratory fish spawning.

9.0 FENCES AND CATTLEGUARDS

9.1 All fences crossed by this powerline shall be provided with a gate not less than 16 feet wide. All fences crossed by the right-of-way or access roads shall be "H" braced, as shown in drawing 503-38-71 (attached), before the fence is cut.

9.2 Cattleguards, when required, shall be aligned at right angles with the roadway and shall be accompanied by an off-road gate wide enough for all construction equipment.

9.3 The CONTRACTOR shall immediately replace all fencing and gates that are cut, removed, damaged, or destroyed by him with new materials to the original standard, except that undamaged gates may be reused.

10.0 GROUNDING

10.1 Barbed wire and woven wire fences on the right-of-way shall be grounded as shown by drawing 503-38-71 and the construction specifications. At a minimum, fences which cross the right-of-way shall be grounded on each side of the gate opening and at each edge of the right-of-way. Fences which run on the right-of-way parallel to the centerline shall be grounded at a maximum of 200 foot intervals.

10.2 All metallic objects other than fences which are on the right-of-way, such as buildings with metallic roofs sides and metallic piping systems installed above ground, shall be adequately grounded.

10.3 Generally, metallic objects off the right-of-way shall not require grounding; however, each metallic installation insulated from ground shall be reviewed on an individual basis to see if grounding is needed.

11.0 EROSION AND SEDIMENT CONTROL

11.1 Construction activities through and in the vicinity of perennial streams shall be in accordance with the State of Montana Natural Streambed and Land Preservation Act of 1975.

11.2 Clearing and grubbing for roads and rights-of-way and excavations for stream crossing shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. Sediment retention basins may be required if silting occurs.

11.3 Roads shall cross drainage bottoms at sharp or nearly right angles and level with the streambed gradient whenever possible.

11.4 Under no circumstances shall streambed materials be removed for use as backfill, embankments, or for other construction purposes. No excavations shall be allowed on any river or live stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

11.5 No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to adequately protect the stream from debris.

11.6 The CONTRACTOR shall maintain roads while using them. All ruts made by machinery shall be filled to prevent channeling. In addition, the CONTRACTOR must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include but are not limited to installing or using cross logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these items.

11.7 The CONTRACTOR is required to prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep slash, excavated materials, and other extraneous materials out of watercourses. Any escaped fill, slash, etc. shall be removed immediately from watercourses.

11.8 Where required, coarse rock encountered in the excavation shall be used as far as praticable for constructing the sides of new embankments adjacent to or parallel with any affected stream where such material may serve as protection against slope or channel erosion. The CONTRACTOR shall be responsible for the stability of all embankments made under the contract until final acceptance of the work. Embankments and backfills shall contain no muck, frozen material, large roots, sod, or other deleterious matter. The CONTRACTOR shall prevent the escape of fill material by the construction of toe ditches or by the erection of rock, boulder, earth, or log barriers at the toes of embankments, or by other suitable methods.

11.9 Culverts or arch bridges shall be installed at all crossings of flowing or dry watercourses where fill is likely to wash out during the life of the road. Culvert or bridge installation is prohibited in areas of important fish spawning beds and during specified fish spawning seasons on less sensitive streams or rivers; these areas shall be identified by the DEPARTMENT prior to centerline approval. Culverts shall be of sufficient size to handle approximately 25-year floods. Culvert size shall be determined following procedures given in the Hydraulics Manual of the Montana Department of Highways (Peil and Weaver, 1975), or by equivalent standard procedures which take into account the variations in vegetation and climatic zones in Montana, the amount of fill, and the drainage area above the crossing.

11.10 No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

11.11 No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads. No perennial watercourses shall be blocked or diverted.

11.12 Construction activities shall use methods that will prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Catchment basins shall be installed at storage areas to contain accidental spills of fuel, chemicals, oil, etc.

11.13 When operations in a work area are complete, all temporary structures or fills installed to aid stream crossing shall be removed and the thread of the stream reestablished to prevent future erosion.

11.14 All temporary dams built on the right-of-way shall be removed within five years of their construction or be upgraded to permanent structures with either spillways or culverts, and a continuous sod cover on their tops and downstream slopes. Spillways may be protected against erosion with riprap or equivalent means.

12.0 ARCHAEOLOGY AND HISTORY

12.1 The OWNER shall engage a competent archaeologist familiar with the area to designate areas likely to be of archaeological and historical significance, and to design an appropriate field survey. Such field work and appropriate mitigative measures shall be completed for any finds prior to the start of construction.

12.2 If any artifacts or items of apparent archaeological or historic significance are discovered before or during construction, care shall be taken not to disturb the artifacts or surrounding area, and the archaeologist shall be notified immediately.

12.3 Any relics, artifacts, fossils or other items of historical or archaeological value shall be preserved in a manner agreeable to both the landowner and the state Historical Preservation Officer.

12.4 Before construction upon lands owned or under the control or jurisdiction of the State of Montana or any Federal agency, there shall be a cultural resource inventory and evaluation in compliance with Executive Order 11593. For all recorded historical and prehistorical sites or properties that meet the criteria for listing on the National Register of Historic Places and that are subject to impact by project activity, procedures required by the National Historic Preservation Act and outlined in 36 CFR 800, and related regulations shall be followed.

13.0 CONTROL OF FIRES

13.1 A fire plan shall be proposed that sets forth in detail the plan for prevention, control and extinguishing of fires on and near the project area.

13.2 The CONTRACTOR shall comply with any county, town, state or governing municipality having jurisdiction regarding fire laws and regulations.

13.3 Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

13.4 The CONTRACTOR shall provide necessary equipment for fire prevention and suppression. The ENGINEER, the BOARD, or its authorized agent may require spark arresters, and additional mufflers on some engines in areas of high fire danger.

13.5 The CONTRACTOR shall properly store and handle combustible material which could create objectionable smoke, odors, or fumes. The CONTRACTOR shall not burn refuse such as trash, rags, tires, plastics, or other debris, except as may be permitted by the county, town, state, or governing municipality having jurisdiction.

14.0 WASTE DISPOSAL

14.1 General cleanup of the right-of-way and access roads shall be done by the CONTRACTOR for the duration of the project.

14.2 Disposal of any materials, waste, effluents, trash, garbage, oil, grease, chemicals, etc., shall be subject to the approval of the landowner.

14.3 All used oil or other petroleum products shall be hauled away. There shall be no release of crankcase oil or other toxic substances into streams or the soil.

14.4 Sanitary waste shall not be discharged into streams or any streambeds. The CONTRACTOR shall provide refuse containers and sanitary chemical toilets, convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local heatlth laws and regulations.

14.5 Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other waste water processes shall not be discharged into surface waters.

14.6 All non-combustible wastes such as conductor, ceramic or metal scrap shall be hauled away or buried. Permission shall be obtained from the landowner before burial of these wastes.

14.7 Complete disposal of all slash made by the project shall be required. Some slash may be used in constructing barriers to inhibit travel on closed roads along the right-of-way. In other locations, slash shall be piled up for disposal according to the ENGINEER's instructions.

14.8 Combustible wastes such as packaging material shall be hauled away and disposed of upon leaving any work area.

14.9 Generally, combustible wastes shall not be burned. In instances where disposal by burning seems preferable, it shall require the prior approval of the landowner, and shall be done with small fires only to dispose of construction waste.

15.0 HERBICIDES

Herbicides shall not be used during construction or maintenance of this line.

16.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

16.1 Subject to the desire of the landowner and the integrity of the tower foundation and anchors, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, stockpiles or excess or waste materials, or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical.

16.2 Grading and scarifying of roadways shall be required where appropriate and required by the landowner or the DEPARTMENT to restore the area to near natural conditions that will permit the growth of vegetation and discourage future traffic.

16.3 Any landscape feature scarred or damaged by equipment or operations shall be restored as nearly as practical to its original condition.

16.4 In areas where no cut or fill was made, closure of roads, subject to landowner approval, shall be done by installing signs, constructing rock barriers, soil berms, planting trees, or other approved means after completion of scarifying, water-barring and revegetation in these areas.

16.5 Replacement of earth adjacent to access roads crossing streams shall be at slopes less than the normal angle of repose for the soil type involved.

16.6 Disturbance of drainage bottoms shall be minimal, and all drainage bottoms shall be restored to their preconstruction gradient and width to prevent accelerated gully erosion.

16.7 Cross drains and water bars shall be added at an angle and as frequently as appropriate to satisfy road grades.

16.8 Interrupted drainage systems shall be restored for all cleared centerlines.

16.9 A detailed revegetation plan, including species used, mixtures, sources of supply, season of application, and equipment to be used shall be specified to the DEPARTMENT by the OWNER 90 days in advance of this phase of construction.

16.10 All litter is to be removed from the right-of-way and along access roads leading to the right-of-way within 30 days of completion of wire stringing and splicing. If requested by the landowner, the OWNER shall provide for removal of any additional debris after this initial cleanup.

16.11 Any existing waste material moved or disturbed shall be placed on the right-of-way so that it does not form fire hazards or stock barriers, and not block access to the right-of-way or to structure sites. Waste material includes disposable material such as tops, limbs, brush, uprooted stumps, unmerchantable logs, buildings designated for disposal, building debris, and other disposable debris. The degree of disposal to be performed is dependent on the existing land use. Occasional tops, limbs, and brush to 3 inches in diameter and to 3 feet in length may be left on other than cropland and residential land.

16.12 Piling and windrowing of material for burning shall be by tractor equipped with a forked clearing blade except where equipment is prohibited. In areas where such equipment is prohibited, methods that will prevent soil from being included in the material to be burned shall be used to minimize destruction of ground cover, and to minimize erosion. Piles shall be relatively small and compact so as to minimize danger to timber and damage to ground cover.

16.13 During allowed open burning operations the CONTRACTOR shall get permits and comply with the requirements of State and local air pollution control and fire authorities. Burning shall only be allowed in locations approved by the ENGINEER, and during appropriate weather conditions. The debris for burn piles shall be kept as clean and dry as possible and burned in a manner to reduce smoke.

16.14 The OWNER is responsible for correcting cultivated land compacted by equipment.

16.15 If difficulties in revegetation are anticipated, stockpiling of topsoil to be spread on road cuts prior to reseeding is encouraged.

16.16 Sufficient seeds and fertilizer, of specific percentage purity, germination, and inert material, shall be ordered early enough to ensure reseeding during the first agricultural planting season after construction ends for each segment of line.

16.17 Where appropriate, hydroseeding or drilling and seeding shall be used to aid revegetation. Mulching with straw or wood chips shall be used where necessary.

16.18 Revegetation shall not be considered complete until the following criteria are met:

a. In rangeland, coverage of perennial species shall be 30% or more of that on adjacent rangeland the year following revegetation, and 90% or more of the coverage of adjacent rangeland when the bond period is up.

b. In forest land, revegetated land exclusive of the right-of-way or permanent roads shall be stocked with trees by the end of the bond period so that the approximate stocking level of adjacent forest, or canopy closure, whichever is less, will be attained at maturity.

The completion of revegetation shall be certified, after field inspection, by the DEPARTMENT or its agent.

17.0 POST-CONSTRUCTION ACTIVITY

As a follow-up after construction, the following shall be done, subject to the desires of the landowner:

17.1 Vegetation, particularly that of value to fish and wildlife, which has been saved through the construction process and which does not pose a hazard to the powerline, shall be nurtured and allowed to grow on the right-of-way.

17.2 Vegetation cover shall be maintained, if ecologically appropriate, in the areas immediately adjacent to transmission towers.

17.3 Native trees, shrubs, herbs and grass shall be kept; where ecologically appropriate in critical areas, vegetation of this type shall be placed under the direction of the appropriate land management agent or a qualified ecologist.

17.4 If and where permitted, access roads and service roads shall be maintained with grass cover, water bars, cross drains, and the proper slope in order to prevent soil erosion.

17.5 Maintenance inspections shall be timed so that routine maintenance will be done when access roads are firm, dry or frozen. Maintenance vegetative clearing in particularly critical areas shall be done on a short cycle to satisfy minimal requirements and to avoid heavy, long-term cutbacks.

17.6 Aircraft shall normally be used to inspect the powerline facility. Aerial inspection and ground maintenance activities of the powerline facility shall include observations of soil erosion problems, fallen timber, and conditions of the vegetation that require attention.

Appendix F

PERTINENT CORRESPONDENCE

This appendix contains pertinent correspondence and guidance for the Cutstrip TCE as referenced in the report.

Appendix F

PERTINENT CORRESPONDENCE

This appendix contains pertinent correspondence and guidance for the Colstrip TER as referenced in the report.

MEMORANDUM OF UNDERSTANDING

BETWEEN

FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE,

AND

BONNEVILLE POWER ADMINISTRATION,

UNITED STATES DEPARTMENT OF THE INTERIOR

To set forth requirements and procedures when Bonneville Power Administration occupies and uses National Forest System lands, within Idaho, Montana, Oregon, Washington and Wyoming for construction, operation, and maintenance of various facilities associated with the transmission of electrical power.

WHEREAS, the Forest Service manages the National Forest System; and

WHEREAS, the Bonneville Power Administration constructs, operates, and maintains certain facilities pertaining to the transmission of electrical power;

CONSEQUENTLY, the Forest Service, through the Chief, and Bonneville Power Administration, through the Administrator, agree as follows:

1. Forest Service will grant occupancy and use of National Forest System lands to Bonneville at locations mutually acceptable to the Forest Service and Bonneville. The Forest Service and Bonneville will work together in order that facilities may be located, designed, constructed and maintained to meet Bonneville's responsibility for power transmission consistent with National Forest objectives and those laws applicable to the management of the National Forest System.

2. Bonneville will involve the Forest Service on a continuing basis in the various planning and analysis processes concerning new facilities as soon as it is anticipated that use of National Forest System land should be considered as one of the possible location alternatives; and the Forest Service will engage in long-range planning with Bonneville to assure that all necessary actions such as multiple use planning, environmental analyses, environmental statements, and public involvement are completed and evaluated on a coordinated, timely basis.

3. When an occasional, unforseen circumstance of high priority is imposed upon an agency and time schedules need to be shortened, both parties will make every reasonable effort to accommodate needs of the other. Such effort will be directed to reducing normal time frames for actions without detriment to the principles and requirements of this agreement.

4. Whenever it is determined by Bonneville or the Forest Service that adverse impacts on forest resources are occurring on National Forest System lands and it is shown to result from a Bonneville facility described in a project plan initiated after date of this Memorandum, Bonneville will take the necessary corrective action to eliminate or minimize the impacts in accordance with a mutually acceptable plan.

5. Bonneville will recognize that the timber cleared from the transmission line rights-of-way and access roads by its contractors may have value. Such stumpage value, as determined by Forest Service appraisals concurred in by Bonneville, could result in a savings in Bonneville appropriations. In the event that timber has not been

disposed of in advance of Bonneville construction by the Forest Service, transfer to the Forest Service of amounts calculated to be equal to this savings will be made by Bonneville.

6. A subsidiary Memorandum of Understanding to implement this master agreement will be entered into by the Regional Foresters and Bonneville Chief, Branch of Land. It shall contain six sections: (1) planning, environmental analyses, environmental impact statements, and programing; (2) transmission, communication, and hydromet facilities; (3) access roads; (4) right-of-way management plans; (5) project plans; and (6) Forest Service land use grant instrument.

7. The parties hereto will schedule a meeting annually or more frequently as needed, to assure maximum opportunity for coordination of their related programs.

8. Each Regional Forester will represent the Chief in all matters pertaining to this Memorandum of Understanding within his Region, except where problems of interpretation arise, in which case the Chief and the Administrator will resolve the issue.

9. This document supersedes the Memorandum of Understanding executed in 1966. The Subsidiary Memorandum of Understanding prepared in accordance with item 6 above replaces all previous Subsidiary Memorandums of Understanding. However, existing Supplements and Permits entered into under the superseded Memorandum and its Subsidiaries, remain in effect.

Philip L Thornton

Acting Chief, Forest Service

May 23, 1974

Date

Donald Paul Hodel

Administrator

Bonneville Power Administration

MAY 30 1974

Date

SUBSIDIARY
MEMORANDUM OF UNDERSTANDING
BETWEEN
FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE,
AND
BONNEVILLE POWER ADMINISTRATION,
UNITED STATES DEPARTMENT OF THE INTERIOR

This document relates to the master agreement of May 30, 1974, entered into by the Chief and Administrator

The Forest Service, through the Regional Foresters of Regions 1, 4, and 6, and Bonneville Power Administration, through the Chief, Branch of Land, agree as follows:

SECTION I. PLANNING, ENVIRONMENTAL ANALYSES, ENVIRONMENTAL IMPACT STATEMENTS, AND PROGRAMING

A. Planning

Bonneville and the Forest Service recognize the importance of planning and agree to coordinate their respective planning efforts as follows:

Bonneville and the Forest Service will meet annually or as otherwise agreed to exchange long-(8+ years) and short-range (1-7 years) plans of mutual interest. Examples of such plans include transportation plans, timber management plans, land use plans, Wilderness proposals, major transmission line corridors and routes, hydromet network and communications facilities. Bonneville will initiate the annual meeting. Either party may initiate a meeting or provide information on new developments as the need arises.

Bonneville will notify the Forest Service of individual proposed new facilities and programs affecting National Forest System lands as soon as they become known. Each will solicit the other party's participation in the development of plans which might affect the other. Bonneville will coordinate its reconnaissance efforts on facilities and programs affecting National Forest System lands with the Forest Service.

To enable completion of the planning and reconnaissance efforts, it may be necessary for Bonneville to conduct field surveys for proposed road and facility rights-of-way to obtain data related to the development of the project plan. Such surveys would be made along routes agreed upon between the Forest Supervisor(s) and the Location and Mapping Section Head for Bonneville.

B. Environmental Analyses and Environmental Impact Statements

As Federal agencies, Bonneville and the Forest Service have a legal mandate under the National Environmental Policy Act of 1969. This Act sets forth a general environmental policy and several specific requirements for Federal agencies. The specific requirements include the following: All agencies of the Federal Government shall (1) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment, (2) insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical consideration, (3) study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources, (4) initiate and utilize ecological information in the planning and development of resource-oriented projects, (5) prepare a detailed statement on major Federal actions significantly affecting the quality of the human environment, and (6) make available such statements to the public. In recognition of the above, Bonneville and the Forest Service will conduct environmental analyses and prepare environmental impact statements in accordance with their individual procedures. Where no environmental statement is planned on a new proposal or facility affecting the other agency, the proposing agency will provide the affected agency with its environmental analysis report. Where an environmental statement is to be prepared, the agency initiating the proposal will take the lead in statement preparation. The other agency will actively participate in development of the statement by (1) providing the lead agency existing information and data concerning the subject area(s) and (2) review and comment on the draft and final environmental statement.

C. Programing

This part of the management cycle involves formulating program alternatives based upon the results of steps A and B above. These program alternatives are then subjected to each agency's budgeting process.

SECTION II. TRANSMISSION, COMMUNICATION, AND HYDROMET FACILITIES

A. Power Transmission Facilities

The elements of location and construction of transmission facilities are covered under "Project Plans" within this document. Although Bonneville routinely inspects and maintains its transmission facilities, the Forest Service will report any observed or potential facility damage to Bonneville. Forest Service proposed activities or permitted uses adjacent to the lines will be coordinated with Bonneville to assure that such activities and uses are appropriate in consideration of the safety of the facility and National Forest users.

B. Communication and Hydromet Facilities

The Forest Service will take the lead in coordination of requests for communication and hydromet needs to provide necessary sites which are consistent with National Forest land management concepts and minimize the total number and size of sites occupied for the aggregate of these purposes by nonexclusive shared use. Bonneville concurs with the concept of shared uses insofar as technically possible and consistent with operational and security restraints to provide the maximum needed reliability within the facility. Bonneville will perform exploratory surveys in preparatory phases leading to the "Project Plan" and development of the facility.

Hydromet facilities in the Columbia River Basin are covered by a separate interagency Memorandum of Understanding between State and

Federal agencies to which Bonneville is a signatory. It is the intent of the Forest Service to cooperate with the various signators and nonsignators in providing coordinated hydromet facility locations.

In those cases where the network(s) will encompass more than one Region or National Forest, the Forest Service will normally designate a single representative to coordinate the overall conceptual uniformity of the proposal.

SECTION III. ACCESS ROADS

Road access is needed for the construction and maintenance of Bonneville transmission, communication and hydromet systems. The Forest Service is charged with the management of National Forest lands and the development of a system of roads to serve the various land uses. The public interests are best served by a stable coordinated system of roads which serve the identified needs of both agencies in full compliance with the laws, Departmental regulations and Executive Orders outlining and governing operational, environmental and ecological concepts. Joint planning of the road location and criteria will be entered into by Bonneville and the Forest Service at an early stage during Bonneville facility planning and the coordinated efforts will be continued through the progressive project development.

A. Each National Forest has a basic transportation plan. Permanent roads built to serve any Bonneville facilities, including power transmission, communication and hydromet systems, will be integrated into this transportation plan through joint planning.

1. All transportation facilities and appurtenant facilities will be located, designed, and constructed compatible with Forest Service Land Use Plans.
2. Proper recognition will be given to the purpose of the road, period of use, land use objectives, and prescriptions, as well as to the safety and economics of the road. Soil characteristics, terrain and the potential for soil erosion into the water courses will be considered.

B. The following tables define project terminology:

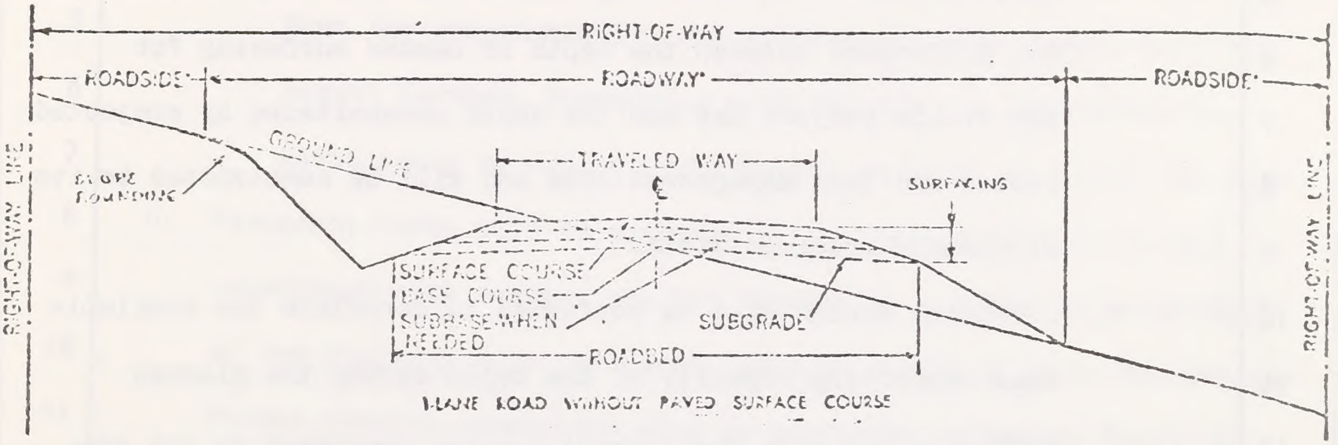
Exhibit 1

Comparative Terminology

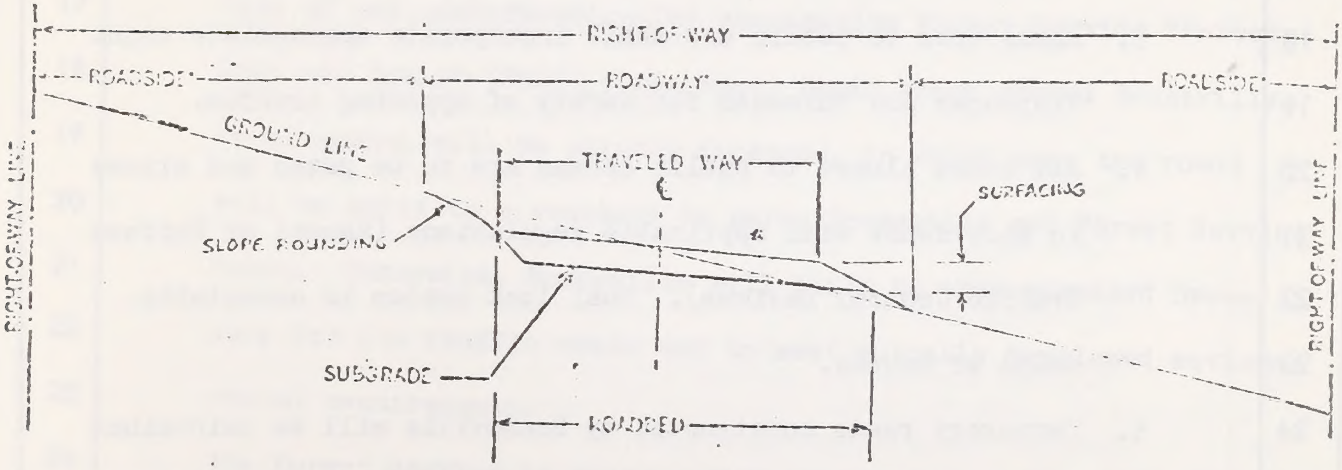
Under 36 CFR 212.1 through .12			FOREST SERVICE TERMS	DEFINITION, EXAMPLES	BONNEVILLE TERMS	
Non-System Roads		Public normally not allowed on these roads	Temporary Road	A road built for a singular purpose & then obliterated. Obliteration is normally by reshaping the disturbed area to approximate adjacent ground conditions & providing vegetative cover appropriate to the site.	TEMPORARY	Temporary non-tower construction access
Forest Development Road (System Roads) Defined in Title 23 U.S.C. 101	These are under the jurisdiction of the Sec. of Agric. & are not considered public roads		LUP (Land Use Project)	A project road intended for recurrent entry to tower locations for routine & emergency needs. The developed criteria includes use prescriptions such as equipment restrictions for use outside of the conditions anticipated in the design. Road length generally does not exceed 1 to 1½ miles.	PERMANENT	Tower Access (two or less towers) Main (three or more towers)
		Public allowed on these roads at discretion of Forest Service	LU (Land Use)	The road is built for the utilization of multiple activities within the road's tributary area. The traffic types are therefore mixed, including those used by the casual Forest visitor. The road is designed for use by highway oriented vehicles. (Generally 1-lane, w/turnouts. Grade up to 8 percent w/exceptions.)		
			LA (Land Access)	This road provides primary access through Forest lands. It provides through & unrestricted public access on the Forest Service road system (ultimate 2-lane).		
	These may be under jurisdiction of Sec. of Agric. or Public Road Agency		IDR (Interim Development Route)	This is simply a specialized case of an LA road. The designation indicates that the route is potentially a public road. When the responsibility for the road is assumed by a public road agency, the road is classed a public road.		
Defined in 23 U.S.C. 101	Under the jurisdiction of a Public Road Agency		FH (Forest Highway)	A portion of a Federal-Aid System occupying National Forest System lands and designated a Forest Highway.		

Exhibit 2

CROSS-SECTION AND ROAD STRUCTURE TERMS



CROWNED SECTION



1 LANE ROAD WITHOUT CROWNING

* THE RATE AND DIRECTION OF TRANSVERSE SLOPE TO BE DETERMINED ON EACH PROJECT

C. The "Project Plan" will identify the road considerations and timing elements of the proposal.

1. System roads are to be designed to support the loads imposed upon them without permanent deformation of the subgrade. Stage construction of a single-lane facility is restricted to the difference between the depth of needed surfacing for Bonneville project use and the depth necessitated by projected public and land management uses and will be constructed to its ultimately required width.
2. Surfacing design will be performed to correlate the available load supporting capacity of the soils during the planned season of use with the imposed loading generated by the project. Cut and fill conditions will be considered and the design bearing value based on the lesser supporting value. In the case where construction densities are not obtained to the lesser design value Bonneville will take steps to obtain the necessary support.
3. Roads open to public use shall incorporate appropriate sight distances and turnouts for safety of opposing traffic.
4. All roads closed to public access are to be gated and signed in accordance with applicable regulations (Manual of Uniform Traffic Control Devices). Dual lock system is acceptable means of access.
5. Temporary roads constructed by Bonneville will be maintained and protected by Bonneville during the life of the construc-

tion after which the road will be obliterated and the area restored.

6. The "Project Plan" will identify the responsibility for maintenance on existing roads during Bonneville construction. When the responsibility for performance will remain with the Forest Service, Bonneville will require its contractor to participate by deposit of appropriate funds to cover the work.

D. Permanent roads will be accepted on the Forest Service system coincident with overall project completion. Prior to acceptance of the facility onto the Forest Service system a joint Bonneville-Forest Service inspection will be performed to assure facility acceptability.

E. No closures will be effected which serve to deny official Forest Service or Bonneville traffic for emergency or direct management entry.

F. Bonneville facility financing proposals will include identification of and justification for cooperative Forest Service "Forest Road and Trail" (FR&T) financing. Roads which exceed Bonneville requirements will be jointly financed, in which case the roads will be built to a standard to serve Bonneville and Forest Service needs. Otherwise, Bonneville will build to that standard necessary for its traffic needs and to meet mutually developed environmental requirements.

G. The Forest Service is charged with the operational management of the Forest Development Road System whereas Bonneville has need to use portions of the existing system for facility construction and maintenance.

1. Portions of the accepted permanent Forest Development Road System may be closed to other than Bonneville traffic for agreed periods of time. When such a need is identified, Bonneville shall not manage the closure without the agreement of the Forest Service. Closure periods are variable according to the anticipated need and Bonneville requests will outline the period requested and the controls it or its contractors will provide through the proposed periods.

2. System nonpublic use roads serving Bonneville activities will normally be operated in a closed road status. When Bonneville project work requires gates or barriers to be left open, access control is to be maintained by Bonneville project personnel.

3. Normal administration, inspection, and small maintenance vehicle traffic operated by either party will be allowed recurrent access without special charge for road maintenance work.

H. Nothing in this Subsidiary Memorandum shall be construed to relieve Bonneville or its contractors of responsibility to correct or otherwise fully compensate for the correction of any damage caused by Bonneville construction and/or maintenance operations; nor to relieve the Forest Service of its correlative responsibility to provide operational management.

I. "Cooperative Cost-Share" Forest Development Roads

The Forest Service has, in designated areas (agreement areas) where lands are partly administered by the Forest Service and partly by private and other ownerships, joined in cooperative agreements for planning, constructing, reconstructing, improving, maintaining and using an adequate coordinated road system.

In those agreement areas where Bonneville operations may be involved, it is mutually agreed:

1. The Forest Service represents the U.S. Government in all road negotiations within an agreement area. Bonneville may participate as a third party when mutually agreeable in cost-share agreement areas for planning, constructing, reconstructing, improving and maintaining specified Forest development access roads as needed or used in the construction of Bonneville transmission lines.

2. Cost of road construction, improvement or maintenance on cost-share roads will be shared by Bonneville and its contractors in the proportion that its use bears to the total use on the system road or segment(s) thereof.

3. Bonneville can participate in joint financing in cost-share agreement areas by performance by Bonneville and its contractors or by depositing funds to the Forest Service.

SECTION IV. RIGHT-OF-WAY MANAGEMENT PLANS

Bonneville and the Forest Service will work together to achieve a program of continuing management of transmission line and road rights-of-way which represents an optimum blend of Bonneville power transmission objectives and National Forest resource management objectives. This will be documented for each facility in a jointly prepared Right-of-Way Management Plan. The Forest Service will take the lead in preparing the plan unless otherwise agreed.

The Forest Service has the land management responsibility for rights-of-way. Bonneville will carry out its program in a manner which will protect or enhance the basic forest resource values. Where additional output of National Forest resources can be obtained through special management of the rights-of-way, Forest Service will have this responsibility.

Prior to completion of construction on any new power transmission facility, the Forest Service and Bonneville will prepare a plan of management for the line and road rights-of-way.

The Right-of-Way Management Plan is to be a detailed working plan, consisting normally of (I) Title and approval page, (II) an Introductory Statement outlining background and specific objectives, (III) a Graphic Section which identifies planned management and protection practices by location, and (IV) a concise Written Section which describes practices and responsibilities.

Management decisions must be specific as to responsibilities, restrictions, and timing based on current and foreseeable opportunities to accomplish sound management on the rights-of-way consistent with Bonneville's needs. Initial preparation and needed subsequent modifications of Right-of-Way Management Plans for existing and new facilities will be carried out at field levels. The Forest Supervisor will sign plans for the Forest Service. The Area Operation and Maintenance Manager will sign for Bonneville.

SECTION V. PROJECT PLANS

After a new specific project on National Forest System land is agreed to by the Forest Service, a Project Plan will be entered into by the Forest Supervisor(s) and Bonneville Chief, Branch of Land before any construction is started. Bonneville will take the lead in preparing Project Plans unless otherwise agreed.

The Project Plan will cover all of the important project details which are related to the protection, management and use of National Forest System land.

When a proposed project involves more than one National Forest, there will be only one Project Plan. The single plan will be executed by all Forest Supervisors and Bonneville Chief, Branch of Land.

Once a land use grant has been made to Bonneville by the Forest Service, no substantial reconstruction or relocation of the existing facilities within the project area may be authorized until the Project Plan is amended and approved accordingly. If a second additional project is proposed within an already existing project area, then a separate Project Plan will be required for the new proposal.

Examples of the kinds of things to be covered in a Project Plan are:

1. Responsibilities and Coordination
   a. Designated Forest Service Project Coordinator.
   b. Designated Bonneville Project Coordinator.
   c. Formal, periodic coordination meetings.

d. Forest Service identification of the specific, authorized responsibility, authority, and accountability at the Forest level concerning the Project Coordinator, District Ranger(s) and Forest Supervisor(s).

e. Bonneville identification of the specific, authorized responsibility, authority and accountability concerning the Project Coordinator and others at the local level.

f. The working interrelationships between the various people identified in d and e above.

2. Financing

a. Mutual financing of roads.

b. Bonneville financing of Forest Service Project Coordinator.

c. Financing of work performed by one agency for the other.

d. Timber settlement agreement.

3. Environment

a. Highlights of the constraints identified in the project environmental analysis.

b. Detailed environmental protection, enhancement and restoration measures required unless incorporated into the needed designs and specifications covering the various project jobs and phases (see item 7 below).

4. Right-of-Way

Tentative decisions on land management objectives for the right-of-way following construction.

5. Fire Management

a. Patrol.

b. Protection equipment.

c. Suppression.

6. Work Camps

a. Authorization.

b. Standards.

7. Designs and Specifications

a. Specifications for clearing and construction of facilities.

b. All necessary construction specifications and standards relating to the management, protection, enhancement and restoration of the National Forest values.

8. Scheduling

a. Inspections: potential problems; existing problems; acceptance of work performed; contract compliance.

b. Authorized time periods concerning such things as clearing, slash burning, road construction and use of overland vehicles with the constraints identified pertaining to weather conditions, etc.

SECTION VI. FOREST SERVICE LAND USE GRANT INSTRUMENT

The Land Use Grant Instrument is included in this section as Exhibit 3. After a new, specific project on National Forest System land is agreed to by the Forest Service, Bonneville would be authorized to occupy and use an established area for construction, operation and maintenance of its facility once the Land Use Grant Instrument is issued. The Instrument would not be issued, however, until after the Project Plan is consummated.

Exhibit 3

2740

U.S. FOREST SERVICE

LAND USE GRANT INSTRUMENT
BONNEVILLE POWER ADMINISTRATION
POWER TRANSMISSION FACILITY, ACCESS ROAD(S),
COMMUNICATION AND HYDROMET FACILITIES

Nature of action or authorization conveyed
by this Instrument: ____________________
____

LUR IDENTITY CODE ____
(Region, Forest, User No., Case Date)

In accordance with Section Six (VI) of the Subsidiary Memorandum of Understanding, this Instrument sets forth the special conditions and general information applicable to the

____________________ Transmission Facility
Access Road(s), Communication or Hydromet Site(s) (delete those not applicable)

1. Project Plan

2. Location: (Legal description, or name of peak or local landmark)

3. Bonneville Drawing Reference Numbers:

4. Technical Parameters (Communication or Hydromet Facility) on the attached 2700-10 dated: ____________________
5. Length Transmission Line: (from Project Plan, miles N.F.) ______
6. Length Access Road(s): (from Project Plan, miles N.F.) ______
7. Area: (from Project Plan, acres N.F.) ____________________

Page 1 of 2

8. A Right-of-Way Management Plan will be prepared by the Forest Service and approved by Bonneville by: ________________(date).

9. District Ranger(s) in charge of maintenance and right-of-way management planning and execution:

Ranger District	Address
____________________	____________________
____________________	____________________
____________________	____________________

10. Area Operations and Maintenance Manager(s) in charge of maintenance:

Area	Address
____________________	____________________
____________________	____________________
____________________	____________________

APPROVED FOR THE FOREST SERVICE, Region ______

____________	____________	____________
(Date)	(Signature)	(Title)

APPROVED FOR BONNEVILLE POWER ADMINISTRATION

____________	____________	, Chief, Branch of Land
(Date)	(Signature)	

Page 2 of 2

APPROVED

Forest Service:

Steve Yurich July 8, 1974
STEVE YURICH Date
Regional Forester, R-1

Vern Hamre June 24 1974
VERNON HAMRE Date
Regional Forester, R-4

T.A. Schlapfer JUN 11 1974
THEODORE SCHLAPFER Date
Regional Forester, R-6

Bonneville Power Administration:

Thomas J. Kornelis JUN 4 1974
THOMAS KORNELIS Date
Chief, Branch of Land

ATTACHMENT A

OFFICIAL FILE COPY
No. Date NOV 22 1976
Referred To: 1//
Action Taken:
☐ ANS. ☐ NO REPLY
By Date

UNDER SECRETARY

UNITED STATES
DEPARTMENT OF THE INTERIOR
WASHINGTON

November 15, 1976

Memorandum

To : Administrator, Bonneville Power Administration
Through: Deputy Assistant Secretary--Energy and Minerals

Raymond A. Peck, Jr. 11/17/76

From : Deputy Under Secretary

Subject: Colstrip Project, Montana Power Company, et al

I have assessed the events since February 22, 1974, when I designated the Bureau of Land Management as lead bureau for the preparation of an environmental statement for the Colstrip Project. These events include:

1. The Governor of Montana's decision not to participate with us in the preparation of a joint Federal-State environmental statement (July 1974).
2. The filing of a final environmental statement by the Montana Department of Natural Resources and Conservation under the provisions of the Montana Utility Siting and Environmental Policy Acts (January 1975).
3. The Secretary's decision initiating a regional environmental statement for coal and related development activities in the Powder River Basin in Montana under the leadership of the Geological Survey (May 1976).
4. The decision of the Montana Board of Natural Resources and Conservation regarding the siting of Colstrip Units 3 and 4 and the associated transmission lines (July 1976).
5. The continuing and increasing importance of the Colstrip Project in meeting electrical load growth in Montana and the Pacific Northwest.

In light of these factors, I have decided to transfer lead agency responsibility for the preparation of an environmental statement to the Bonneville Power Administration.

The scope of the statement must include all Federal actions associated with the project and must cover the impacts associated with the power plant, the water supply, the coal supply, and the transmission system.

There are a host of data sources and environmental analyses available for this task, and, by copy of this memorandum, I am requesting the Office of Environmental Project Review to provide you with appropriate references from their files.

You are requested to prepare a plan of study, including a schedule, in consultation with other involved jurisdictions (Geological Survey, Bureau of Land Management, Fish and Wildlife Service, National Park Service, Bureau of Reclamation, Bureau of Indian Affairs within the Department; the Forest Service; and appropriate State agencies) and submit it by December 15, 1976, to the Office of Environmental Project Review for approval.

In this regard, the following guidance is provided:

> Relationship with Regional Coal EIS - The regional statement is being prepared in two parts with one part providing an overview of the regional impacts of all coal and related developments which are projected to occur over the next fifteen years and the other providing a series of site-specific environmental analyses for pending Federal coal-related actions. Conceptually, the Colstrip EIS may be considered as one of the site-specific analyses which is being packaged as a separate document because its scope extends considerably beyond that of the regional EIS. Accordingly, the Colstrip EIS team should provide the regional EIS team with a brief description of the Colstrip Project and a brief summary of its impacts for inclusion in the regional analysis. In addition, the Colstrip EIS should clearly reference the regional EIS for analysis of the project's contribution to regional impacts. It is obvious from this that there must be a close working relationship between BPA and GS.
>
> Power Plant - Independently review, summarize, and augment, as required, the aggregate and cumulative impacts of Units 1-4 included in the State EIS and supporting documents. References to the State EIS are appropriate for more detailed information, but references alone will not suffice because of the State's biased analysis and our strong criticisms of it.
>
> Water Supply - Same as the Power Plant, above, but consult with BLM, BR and Corps of Engineers to ensure that all Federal actions and impacts are included.
>
> Coal Supply - If the regional DES is scheduled to be issued earlier or about the same time as the Colstrip DES, then merely identify the coal source and reference the regional EIS. If the Colstrip DES will significantly precede the regional DES, then a brief summary of the associated site-specific coal mining impacts will have to be included (GS should provide) as well as a reference to the pending regional EIS.

Transmission System - The "proposal" should be the corridor approved by the State and the alternatives should include those considered by the State. We want to emphasize that, if there are any Federal or Indian objections or reservations to the State's approved corridor or stipulations, appropriate alternatives must be developed. This will allow the Secretaries of Agriculture and/or Interior to compare alternatives and make decisions. In this regard, the statement itself shall not make alternative route recommendations.

The other involved Interior bureaus are expected to be represented on the Colstrip EIS team and to lend support in areas of their respective responsibilities.

By copy of this memorandum, I am informing the Forest Service of this change in leadership for the Colstrip environmental statement and requesting their continued cooperation and participation.

W. W. Lyons

W. W. Lyons

cc: Assistant Secretary--Energy and Minerals
Assistant Secretary--Fish and Wildlife and Parks
Assistant Secretary--Land and Water Resources
Assistant Secretary--Program Development and Budget
Director, Bureau of Land Management
Director, Bureau of Mines
Director, Geological Survey
Director, Fish and Wildlife Service
Director, National Park Service
Commissioner, Bureau of Indian Affairs
Forest Service, Department of Agriculture

OKK

August 12, 1977

John Evans
Asst. Chief Engineer & Mgr. of Engineering
Montana Power Company
P.O. Box 1338
Butte, Montana 59701

Dear John:

I understand your Company has entered into agreement with the Montana Department of Natural Resources to perform centerline location work for the proposed Colstrip transmission line between Helena and Colstrip.

This letter reiterates and supplements my correspondence of March 22, 1977, to Cecil Weeding, Chairman of the Montana Board of Natural Resources and Conservation, a copy of which was sent to you. By so proceeding to locate centerline, obtain right-of-way easements, design the towers, and order material, there is a risk your Company will incur financial expenditures which may be lost if the Federal government either (1) denies the permits necessary to allow the Colstrip Project to be constructed, or (2) places conditions upon issuing permits such that the transmission line in whole or part must be located within a different corridor than the one presently approved by the State of Montana.

The Federal government cannot make a judgment as to the probability of such denial or relocation occurring. Such judgment must be exercised by the Applicants.

Sincerely yours,

Original Signed By
RONALD H. WILKERSON

Ronald H. Wilkerson
Colstrip EIS Manager

cc:
Cecil Weeding, Chairman
Montana Board of Natural Resources
and Conservation
Jordan, Montana

John Orth
Department of Natural Resources
and Conservation
Helena, Montana

Robert Torheim
U.S. Forest Service
Missoula, Montana

Edwin Zaidlicz
Bureau of Land Management
Billings, Montana

James Canan
Bureau of Indian Affairs
Billings, Montana

Copies also sent to: Bruce Blanchard and
Gary Bohlke

Official File - OKK

J. O. Hooson - EE
J. Elizalde - SH
E. H. Wirtz/J. Pyrch - ETI

O. Halvorson - XOHS
N. A. Gilchrist - OK

RHWilkerson:smh

bcc:
D. F. Hodel - A
R. S. Gens/D. E. Johannson - EI

OKX.

August 17, 1977

Memorandum

To: Bruce Blanchard
Office of Environmental Project Review

From: Ronald H. Wilkerson, Colstrip EIS Manager
Bonneville Power Administration

Subject: Colstrip Project EIS, August 5, 1977, Meeting Regarding Evaluation of Transmission Alternatives

This memorandum summarizes discussions during the meeting. In attendance were you, Libby Stone and Victoria Evans of the Office of Environmental Project Review; Gary Bohlke, Solicitors Office; Herb Stewart, USGS; Dick Ellison, BLM; Omar Halvorson, Office of Regional Solicitor (Portland, Oregon); and Don Johannson, Engineering Manager, John Pyrch, Environmental Planning Coordinator for the Colstrip Transmission Studies and me of Bonneville Power Administration.

The purpose of the meeting, called by BPA, was to inform Interior officials of various problems encountered in conducting the Colstrip transmission studies, to brief the officials on the approach BPA intends to use in order to accommodate the problems, and to provide an opportunity for officials to assist BPA by making comments on the approach.

Those present indicated their concurrence in the study approach presented by BPA and as described in the July 15 memorandum from Elmer Wirtz and John Pyrch to Ralph Gens, BPA Chief Engineer. It was understood that the BPA Chief Engineer and those bureaus working with BPA on the transmission studies (BIA, BLM, and FS) also concur in the methodology. For the information of recipients of this memorandum, attached is a copy of the July 15 memorandum to the Chief Engineer which outlines the planned approach, a copy of an August 9, 1977, memorandum from the Office of the Regional Solicitor to John Elizalde which opines that the method is adequate, and meeting handouts on the analysis procedure and organization of the Transmission Environmental Report.

Suggestions and comments made by those present are summarized below:

1. Gary Bohlke asked what alternatives would be addressed by the transmission studies. The emphasis will be on the corridors identified by the Montana Power Company (Westinghouse Environmental Systems Department) and by the State of Montana. The transmission studies will provide a basis for determining the viability and reasonableness of each such corridor. The transmission studies should take into account, of course, that the analysis is on a "corridor" rather than a centerline basis and that sensitive areas on the transmission corridor can usually be avoided by careful selection in centerline locations. It was also recognized during the discussion that an infinite number of alternatives exist. The analysis should be sufficient to determine whether additional alternatives with substantially lesser impacts are available where problem areas are encountered on Public Lands on the proposed corridor.

2. You asked if the transmission study team was going to consider connection points to the BPA system other than Hot Springs or its vicinity. The approved interagency Colstrip Transmission Work Management Plan specifically indicates that this will be the only western terminal area analyzed by the transmission study team. It was agreed the Colstrip EIS should clearly explain the extent of consideration given to other connection points, and the reasons why a detailed impact analysis is not appropriate. Maps supporting the discussion would be useful to people not familiar with Montana. The Forest Service and BPA study on energy transportation corridors across the Rocky Mountains could provide valuable reference material for the EIS input.

3. Gary Bohlke questioned whether the "study area," shown on the maps which John Pyrch used as a visual aid, was restrictive on the alternatives to be considered. During discussion, it was brought out that the study area boundaries were determined after the corridor alternatives had been defined rather than before. The study area simply defines the area for which the existing environment is described. It was also mentioned by John that if evaluation of the alternatives and attendant discussions with land management agencies reveal problems along the identified alternative corridors, the final centerline could be located, in most cases, to alleviate the problem. However, the existing schedule and manpower does not allow for the identification of subalternatives to avoid problem areas along the alternative corridors.

4. It was agreed that Ron Wilkerson should write letters to the State of Montana, Department of Natural Resources and Conservation and the Montana Power Company notifying them about the possibility of not being granted permits to cross Federal lands along the state's approved corridor.

Ronald N Wilkerson
by Betty Lee

Attachments

cc:
Colstrip Review/Advisory Committee Members 13
Herb Stewart - U.S. Geological Survey

RHWilkerson:smh

bcc:
W. H. Clagett - AC
R. S. Gens - E
Omar Halvorson - XORS
N. A. Gilchrist - OK
D. E. Johannson - EH
J. O. Hooson - EE
C. P. Clark - ET
J. Elizalde - SH
E. H. Wirtz - ETI/TER
J. B. Pyrch - ETI/TER
Official File - OKK

BIA - IR-6-1

CKK

September 7, 1977

Mr. Harold Mitchell, Jr., Chairman
Confederated Salish & Kootenai Tribal Council
P. O. Box 355
St. Ignatius, Montana 59865

Dear Harold:

As you know, a Federal interagency team is making an environmental analysis of the transmission corridor proposed by Montana Power Company, and alternative corridors, to move power from Colstrip to the vicinity of Hot Springs. Their findings will be documented in a Transmission Environmental Report (TER). To ensure all concerns are addressed in their report, the study team has scheduled meetings with the Forest Service in Helena on October 13, 1977, and the Bureau of Land Management in Billings on October 14, 1977. The objectives for these meetings are listed below:

1. Inform land managers about preliminary contents of the Colstrip TER;

2. Provide land managers an opportunity to identify general concerns for private and public lands along all corridors. Emphasis will be placed on identification of problem areas on Federal lands along the applicant's proposed corridor; and

3. Provide land managers an opportunity to critique the corridor analysis for weaknesses and data gaps.

Because your Tribal lands are involved in this project, we thought the Council might want to have a meeting also. This would provide the Council an opportunity to review the environmental analysis prior to completing the TER.

If the Council desires such a meeting, representatives of the study team would be willing to present their findings at your October Tribal Council meeting. Perhaps you could discuss this matter during your September Tribal Council meeting and let me know your decision.

If you have any questions, please don't hesitate to call me.

Sincerely yours,

Original Signed By
RONALD H. WILKERSON
Ronald H. Wilkerson
Colstrip EIS Manager

cc:
Fred Houle, Tribal Council Secretary
Albert Rennie, Acting Superintendent, BIA, Ronan

JPyrch:RHWilkerson:smh

bcc:
David Darby, Bureau of Land Management
Claude Roswurm, Bureau of Land Management
David W. Pennington, Bureau of Indian Affairs
Earl N. Reinsel, Forest Service
Charles B. Tribe, Lolo National Forest
J. O. Hooson, Environmental Coordinator - EE
D. E. Johannson - EH
C. F. Clark - ET
R. W. Beraud - SH
J. L. Elizalde - SH
E. H. Wirtz - ETI/TER

ETI/TER September 26, 1977

David W. Pennington
Natural Resources Specialist
F1/c7 Bureau of Indian Affairs
316 North 26th Street
Billings, Montana 59101

Dear Dave:

We have reviewed the social and economic impact discussion as it relates the Crow Tribe in the Crow Ceded Area Coal Lease Tracts II and III Westmoreland Resources draft EIS prepared by the Billings BIA office. We would like to discuss the potential socioeconomic impacts to the Confederated Salish and Kootenai Tribes resulting from the revenues that may result from Colstrip Transmission Project in a similar manner. However, we need the following information about the Indians on the Flathead Reservation:

1. Tribal income data for 1970 through the most recent year available. This information should include the sources of the income and the amount from each source (e.g., oil and gas leases, coal and other mineral leases, timber sales, grazing permits, any tribal-owned businesses, etc.);

2. The uses of the tribal income and the amount spent for each use (e.g., maintenance of the tribal government, community services, economic development, capital improvement, litigation, per capita payments to those on tribal roles, tribal council staff salaries, tribal programs and projects, operational expenses, administration of loans, etc.);

3. The TER impact discussion on tribal income should be based on the wage and salary income earned by the Indians, both agricultural and non-agricultural. Consequently, wage and salary incomes for the Flathead Indians are needed; and

4. If possible, some of the transmission line construction workers may opt to locate their temporary housing on the Flathead Indian Reservation. Do you know what the existing facilities on the reservation are (i.e., hotels, motels, campgrounds, trailer courts, etc.)? If there is any reason why the impacts from these workers would be any different on communities within the reservation than elsewhere, we would like to know.

Thank you for your assistance.

Sincerely,

John B. Pyrch
Environmental Planning Coordinator
Colstrip Transmission Study Team

cc:
E. Wirtz - ETI/TER
J. Hooson - EE
T. Blackburn-Elliot - EE
R. Beraud - SH
Official File - ETI/TER

THE MONTANA POWER COMPANY
GENERAL OFFICES 40 EAST BROADWAY BUTTE MONTANA 59701 · TELEPHONE 406 / 723-5421

JOSEPH A. McELWAIN
PRESIDENT
AND CHIEF EXECUTIVE

September 26, 1977

RECEIVED
SEP 27 1977
Kalispell D. O.
OAK

Mr. Donald P. Hodel
Administrator
Bonneville Power Administration
P. O. Box 3621
Portland, OR 97208

Dear Mr. Hodel:

The Montana Power Company, acting on its own behalf and on behalf of Puget Sound Power & Light Company, Washington Water Power Company, Portland General Electric Company and Pacific Power & Light Company, (Applicants), hereby applies to and requests that the Bonneville Power Administration (BPA), pursuant to the provisions of the Federal Columbia River Transmission System Act, P.L. 93-454, 88 Stat. 1376 (the Act), construct adequate 500 kV electric transmission lines from BPA's transmission system to a point within the transmission line corridor approved by the Montana Board of Natural Resources and Conservation in the Helena-Ovando area, where such lines will interconnect with two 500 kV lines to be built by the Applicants from Colstrip, Montana.

It is our belief and understanding that the construction of the requested transmission facilities is in keeping with the obligations of the Administrator by Section 4 of the Act.

If you need additional information concerning this application, please call me. We request that you arrange for a meeting between the Applicants and the appropriate members of your staff at the earliest possible time in order that this matter be fully discussed.

Very truly yours,

Joe McElwain

JAM:bw
cc. Ron Wilkerson - Kalispell
Wm. Claggett - Washington

Pennington
12/7 1977

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

DEC 2 1977

In reply refer to: EO

Mr. Joseph A. McElwain, President
The Montana Power Company
40 East Broadway
Butte, Montana 59701

Dear Mr. McElwain:

Pursuant to the application in your letter of September 26, 1977, on behalf of The Montana Power Company (MPC), Puget Sound Power and Light Company, Washington Water Power Company, Pacific Power and Light Company and the Portland General Electric Company, the Bonneville Power Administration (BPA) agrees to request Congressional Authorization for the construction of 500-kV transmission and substation facilities from a point on our existing main grid to interconnect with the two 500-kV lines proposed to be built by your company from Colstrip, Montana.

To meet the Colstrip energization schedules it is necessary for us to seek authorization in our Fiscal Year (FY) 1979 program. We are proceeding to comply with the 60-day notice requirement of Section 5 (b) of the Federal Columbia River Transmission System Act and propose to include this project as a supplement to our FY 1979 budget.

As a result of the ongoing technical discussions with your company and the other Colstrip participants, we have reached tentative agreement on the overall technical aspects of the project. Therefore, the project which we will include in our budget will be to construct one double-circuit 500-kV line from a connection with the proposed Colstrip transmission lines in the vicinity of Townsend, Montana, westward to the vicinity of Garrison, Montana, and continuing in a northwesterly direction to a point of connection with BPA's existing main grid. At Garrison, BPA would construct a major new substation which would include 500-kV and 230-kV switching facilities and a 500/230-kV transformer. BPA's

230-kV Anaconda-Hot Springs line and MPC's 230-kV Anaconda-Ovando line would be looped into the substation. As discussed during our technical study meetings, an integral part of the plan requires a connection between the 230-kV and 161-kV systems in the Garrison-Missoula area. We are not including this connection in our budget.

BPA will not expend significant funds until the following conditions have been satisfied:

1. Necessary Congressional Authorization has been received.

2. Final agreement on the electrical plan of service.

3. Satisfactory contractual agreements have been concluded among BPA and the Colstrip Project Management and the individual participants.

4. All necessary permits and approvals for the Colstrip Project have been issued.

5. Compliance with the National Environmental Policy Act of 1969.

The BPA staff will continue to meet with your staff and the other participants to resolve the technical and contractual issues. It will be necessary to achieve significant progress on these issues by the time of the Congressional Hearings in March 1978.

Mr. Ralph Gens, Chief Engineer, will continue to provide the lead on all technical matters. Mr. Hector Durocher, Power Manager, will provide the lead on all commercial arrangements.

Sincerely yours,

(SGD) DONALD PAUL HODEL

Administrator

cc:
John W. Ellis, President, Puget Sound Power & Light Company
W. J. Satre, President, The Washington Water Power Company
Robert H. Short, President, Portland General Electric Company
Don C. Frisbee, President, Pacific Power & Light Company
Richard Anthony Baenen, Washington, D.C.
John Orth, Director, Department of Natural Resources and Conservation

Ltr. to Joseph A. McElwain, Butte, Montana, Subj: Reply to Mr. McElwain's Letter Dated September 26, 1977.

cc: (Continued)
Edwin Zaidlicz, State Director, State of Montana
James F. Canan, Area Director, Bureau of Indian Affairs
Robert H. Torheim, Regional Forester, U. S. Forest Service
Harold Mitchell, Jr., Chairman, Confederation of Salish and Kootenai Tribes of Flathead River Basin
Administrator - A
Deputy Administrator - A
Adm. Chron. File - A
W. H. Clagett - AC
H. Kropitzer - AD
D. W. Schausten - AE
H. J. Durocher - P
O. W. Halvorson - AP
J. N. O'Neal - O
N. A. Gilchrist - OK
R. H. Wilkerson - OKK
J. J. Anderson - OKN
J. H. Alberthal - OP
L. Sutton - OPG
G. A. Tupper - OS
H. M. Cantrell - OW
M. C. Derksema - OWI
S. E. Efferding - S
S. A. Ailshie - SL
R. S. Gens - E
D. E. Johannson - EH
H. D. Hurless - EG/Ross
J. L. Bloodworth - EB
F. G. Schaufelberger - EO
W. H. Simpson - EK
T. Kornelis - EL
H. R. Saldivar - EM
J. L. Jones - EN
C. F. Clark - ET
J. O. Hooson - EE
J. Elizalde - SH
J. Kiley - SJ
Official File - EO

MKlinger:dp 12-2-77

THE MONTANA POWER COMPANY
GENERAL OFFICES 40 EAST BROADWAY, BUTTE, MONTANA 59701 · TELEPHONE
SERVING YOU IS OUR BUSINESS

No.
Date SEP 28 1977
Referred To
Action Taken:
☐ ANS. ☐ NO REPLY
By Date

JOSEPH A. McELWAIN
PRESIDENT
AND CHIEF EXECUTIVE

September 26, 1977

Mr. Donald P. Hodel
Administrator
Bonneville Power Administration
P. O. Box 3621
Portland, OR 97208

Dear Mr. Hodel:

The Montana Power Company, acting on its own behalf and on behalf of Puget Sound Power & Light Company, Washington Water Power Company, Portland General Electric Company and Pacific Power & Light Company, (Applicants), hereby applies to and requests that the Bonneville Power Administration (BPA), pursuant to the provisions of the Federal Columbia River Transmission System Act, P.L. 93-454, 88 Stat. 1376 (the Act), construct adequate 500 kV electric transmission lines from BPA's transmission system to a point within the transmission line corridor approved by the Montana Board of Natural Resources and Conservation in the Helena-Ovando area, where such lines will interconnect with two 500 kV lines to be built by the Applicants from Colstrip, Montana.

It is our belief and understanding that the construction of the requested transmission facilities is in keeping with the obligations of the Administrator by Section 4 of the Act.

If you need additional information concerning this application, please call me. We request that you arrange for a meeting between the Applicants and the appropriate members of your staff at the earliest possible time in order that this matter be fully discussed.

Very truly yours,

Joe McElwain

JAM:bw
cc. Ron Wilkerson - Kalispell
Wm. Claggett - Washington

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
BILLINGS AREA OFFICE
316 NORTH 26TH ST.
BILLINGS, MONTANA 59101

No. Date DEC 19 1977
Referred To:
Action Taken:
☐ ANS. ☐ NO REPLY
By Date

IN REPLY REFER TO:
Environmental Quality

DEC 15 1977

MEMORANDUM

To: Mr. John B. Pyrch
Environmental Planning Coordinator
Colstrip Transmission Study Team

From: Office of the Area Director

Subject: Information needs for the Flathead Indian Reservation

This memorandum is in response to your telecon of December 7 in which you asked for a written response to your letter of September 26, 1977. Your September 26 letter requested information concerning: (1) Tribal income data; (2) Uses of Tribal income and amounts spent for services; (3) Wage and salary incomes for individual Indians, and (4) possible temporary housing locations for transient workers.

As you are aware through past discussions, the information was not submitted to your office. Reasons for non-submittal are detailed below:

1. This office has consistently taken a position of non-participation in the preparation of the Transmission Environmental Report. This position was enumerated in our letters to the Bonneville Power Administration dated February 24, March 18, and April, 1977. The position of non-participation was taken because of the Confederated Salish and Kootenai Tribal Council's decision not to approve right-of-way for the proposed corridor through the Flathead Indian Reservation.

2. The information requested appears to come under the provisions of the Privacy Act, and as such the Tribal Council would have to sanction its release. The Council was contacted concerning your request and in turn have asked their legal counsel for an opinion. To date the Council has not notified us of their intent to provide the information.

In light of the above discussion it is evident that the information will not be forthcoming at this time. U.S. Census information, however, may supply data satisfactory to your needs.

Acting Area Director

Appendix G

BIBLIOGRAPHY

REFERENCES CITED

Allen, E. O., J. V. Basile, K. O. Janson, T. N. Lonner, L. J. Lyon, C. L. Marcum, C. Pond, R. Ream, and J. Self. 1976. Annual Progress Report. Montana Cooperative Elk-Logging Study.

Baglien, J. W. 1975. Biology and Habitat Requirements of the Nesting Golden Eagle in Southeastern Montana. M. S. Thesis. Montana State University, Bozeman. 63 pp.

Balda, R. P. 1975. "Vegetation Structure and Breeding Bird Diversity." Proceedings of the Symposium on Management of Forest and Range Habitats for Nongame Birds. U.S. Forest Service, Washington, D.C. 59-80 pp.

Barbour, R. W. and W. H. Davis. 1969. Bats of America. The University Press of Kentucky, Lexington. 286 pp.

Barley, K. P. and E. L. Greacen. 1967. "Mechanical Resistance as a Soil Factor Influencing the Growth of Roots and Underground Shoots." Advances in Agronomy. 19:1-43.

Barton, H., W. G. McCully, H. M. Taylor and J. E. Box, Jr. 1966. "Influence of Soil Compaction on Emergence and First-year Growth of Seeded Grasses." Journal of Range Management. 19(3):118-121.

Bayless, S. R. 1969. "Winter Food Habits, Range Use, and Home Range of Antelope in Montana." Journal of Wildlife Management. 33(3):538-551.

Baver, L. D., W. H. Gardner, and W. R. Gardner. 1972. Soil Physics. Fourth Edition. John Wiley and Sons, New York.

Bernier, B. and C. H. Winget (eds.). 1975. Forest Soils and Forest Land Management. Proceedings of the Fourth North American Forest Soils Conference, August 1973. Les Presses de l'Université Laval, Quebec, Canada. 675 pp.

Biggins, D. E. 1975. Seasonal Movements of the [illegible] Deer and [illegible]. Montana Department of Fish and Game, Helena. Job Final Report W-120-R-6.

Blaisdell, J. P. 1958. Seasonal Development and Yield of Native Plants. USDA, Bulletin No. 1190.

Blakely, B. D., J. J. Coyle, and J. G. Steele. 1957. "Erosion on Cultivated Land." Soil, the 1957 Yearbook of Agriculture. U. S. Department of Agriculture.

Appendix G

BIBLIOGRAPHY

REFERENCES CITED

Allen, E. O., I. V. Baisle, R. G. Janson, T. N. Lonner, L. J. Lyon, C. L. Marcum, F. Pond, R. Ream, and D. Sall. 1976. Annual Progress Report: Montana Cooperative Elk-Logging Study.

Baglien, J. W. 1975. Biology and Habitat Requirements of the Nesting Golden Eagle in Southwestern Montana. M. S. Thesis. Montana State University, Bozeman. 53 pp.

Balda, R. P. 1975. "Vegetation Structure and Breeding Bird Diversity." Proceedings of the Symposium on Management of Forest and Range Habitats for Nongame Birds. U.S. Forest Service, Washington, D.C. 59-80 pp.

Barbour, R. W. and W. H. Davis. 1969. Bats of America. The University Press of Kentucky, Lexington. 286 pp.

Barley, K. P. and E. L. Greacen. 1967. "Mechanical Resistance as a Soil Factor Influencing the Growth of Roots and Underground Shoots." Advance in Agronomy. 19;1-43.

Barton, H., W. C. McCully, H. M. Taylor and J. E. Box, Jr. 1966. "Influence of Soil Composition on Emergence and First-year Growth of Seeded Grasses." Journal of Range Management. 19:118-121.

Bayles, S. R. 1969. "Winter Food Habits, Range Use, and Home Range of Antelope in Montana." Journal of Wildlife Management. 33(3):538-551.

Baver, L. D., W. H. Gardner, and W. R. Gardner. 1972. Soil Physics. Fourth Edition. John Wiley and Sons, New York.

Bernier, B. and C. H. Winget (eds.) 1975. Forest Soils and Forest Land Managment Proceedings of the Fourth North American Forest Soils Conference, August 1973. Les Presses De L'Université Laval. Quebec, Canada. 675 pp.

Biggins, D. E. 1975. Seasonal Movements of the Spotted Bear Elk Herd. Montana Department of Fish and Game, Helena. Job Final Report W-120-R-6.

Blaisdell, J. P. 1958. Seasonal Development and Yield of Native Plants. USDA, Bulletin No. 1190.

Blakely, B. D., J. J. Coyle, and J. G. Steel. 1957. "Erosion on Cultivated Land." Soil, the 1957 Yearbook of Agriculture. U. S. Department of Agriculture.

Boeker, E. L. 1972. Powerlines and Bird Electrocutions. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife. Unpublished. 8 p.

Bonneville Power Administration (BPA). 1972. Specifications for Clearing the Rights-of-Way and Contruction of Access Roads for the Libby Loop to Noxon-Conkelley 230 kV Line No. 1, the Libby Powerhouse Substation 230 kV Lines Nos. 1 and 2, and a Portion of the Libby-Libby (PP&L) 115 kV Line No. 1, Part I - Specific Information. Portland Oregon.

Bonneville Power Administration (BPA). 1977a. Electrical and Biological Effects of Transmission lines: a Review. Prepared by Biological Studies Task Team, Portland, Oregon.

Bonneville Power Administration (BPA). 1977b. The Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System. Appendix B, BPA Power Transmission. Portland, Oregon.

Bonneville Power Administration (BPA). 1978. Broadcasting Yearbook, 1978. Bonneville Broadcast Consultants Facilities of Television Portland, Oregon. B-114 p.

Bracken, T. D. 1975. Field Measurements and Calculations of Electrostatic Effects of Overhead Transmission Lines. IEEE Paper No. F75573-6.

Brown, C. J. D. 1971 Fishes of Montana. Big Sky Books. Montana State University, Bozeman. 207 p.

Brown, R. L. 1971 "Short-tailed Grouse." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 129-133 pp.

Brown, Hugh (Legal Advisor, Montana Department of Fish and Game, Helena). September 17, 1974. Personal communication as cited in DNRC/DEIS 1974.

Byerly, R. T. and Kimbark, E. W. 1974. Stability of Large Electric Power Systems. IEEE Press, New York.

Chaffee, George B. 1973. Preliminary Study of Rangeland and Forest Cover Types Within Proposed Zone of Influence (Montana), and Addendums. Consultants report to Westinghouse Project ESD-090-73, WESD/AEA 1973.

Compton, H. O. 1973. Upland Game Bird Survey and Inventory - Region Five. Montana Department of Fish and Game, Helena. Job Progress Report Project W130-R4, Job 11-5

Compton, H. J. Egar, and R. Truckload. 1971. "Pronghorn Antelope." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.) Montana Department of Fish and Game, Helena. 80-87 pp.

Consulting Services Corporation. 1966. The Comprehensive Plan. Prepared under contract for the Montana State Planning Board and the Helena City-County Planning Board.

Cooperative Extension Service and Ohio State University. 1975. Ohio Erosion Control and Sediment Pollution Abatement Guide. Cooperative Extension Service, Columbus, Ohio. 20 p.

Craighead, J. J. and F. C. Craighead. 1972. Grizzly Bear Prehibernation and Denning Activities as Determined by Radiotracking. Wildlife Monograph No. 32. 35 p.

Crowley, John M. 1972. "Environmental Regions of Montana." Montana Environmental Quality Council, First Annual Report. 2-11 pp.

Cumin Associates. 1977. Treasure County Planning Data, June 1977 - Population and Economic Background, Fiscal Information, Existing Community Facilities and Services, Existing Land Use. Billings, Montana.

Daily - Peccia and Associates. 1976. Comprehensive Plan - Jefferson County, Montana. Prepared for Jefferson County Planning Board, Helena, Montana.

Davis, C. V. 1973. Birds of Montana. Endowment and Research Foundation. Montana State University, Bozeman. 6 pp.

Deno, D. W. 1974. Calculating Electrostatic Effects of Overhead Transmission Lines.
IEEE Paper No. T74086-5.

Depart. of Natural Resources and Conservation (DNRC/DEIS) 1974. Draft Environmental Impact Statement on Colstrip Electric Generative Units 3 and 4, 500 Kilovolt Transmission Lines and Associated Facilities, Volume 1 through 4. Energy Planning Division, Montana State Department of Natural Resources and Conservation, Helena.

Depart. of Natural Resources and Conservation DNRC/FEIS 1975. Final Environmental Impact Sattement on Colstrip Electric Generating Units 3 and 4, 500 Kilovolt Transmission Lines and Associated Facilities. Energy Planning Division, Montana State Department of Natural Resources and Conservation, Helena.

Dyksterhuis, E. J. 1951. "Use of Ecology on Range Land." Journal of Range Managment. 14(5).

Dyksterhuis, E. J. 1957. "The Savanna Concept and Its Use." Ecology. Volume 58.

Dyksterhuis, E. J. 1964. Estimated Total Annual Yields in Climax by Sites. USDA, Soil Conservation Service.

Eichin, P. E. and H. D. Hurless. 1975. Joint Utility Corridor and Right-of-Way Practices of the Bonneville Power Administration. IEEE Paper No. A76 163-1.

Electric Power Reserach Institute (EPRI). 1975. Transmission Line Reference Book 345 kV and Above. Distributed by Fred Weidner and Son, Printers, Inc., New York. 393 p.

Erickson, A. W. 1976. Grizzly Bear Management in the Thompson Falls Area and Adjacent Environs. U.S. Forest Service. Missoula, Montana. 58 p.

Erickson, Dave (Planner for Lake County, Montana). October 12, 1977. Telephone conversation with Toni Blackburn/Elliot.

Fenneman, N. M. 1931. Physiography of Western United States.

Ferguson, A. H. (Professor of Soil Physics, Montana State University, Bozeman). 1977. Personal communication.

Flath, D. L. 1977. Montana Non-Game Species of Special Interest or Concern. E&I Division, Montana Department of Fish and Game, Helena. 72 p.

Flath, Dennis (Non-Game Biologist, Montana Department of Fish and Game, Bozeman). June 1977. Telephone conversation with John Baglien.

Fog, J. 1970. "Effect of High Voltage Electrical Lines in Flying Height of Anatidae." Flora Fauna, Silkeborg. (English summary). 16:141-144.

Forbis, Richard G. 1955. The MacHaffie Sites. Unpublished doctoral dissertation. Columbia University, New York.

Foss, A. and M. Rognrud. 1971. "Rocky Mountain Goat." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 106-113 pp.

Frederickson, R. L. 1972. "Impact of Forest Management on Stream Water Quality in Western Oregon." Pollution Abatement and Control in the Forest Products Industry. Reproduced by the USDA Forest Service. 50 p.

Frydman, M. A. Levy and S. E. Miller. 1972. Oxidant Measurements in the Vicinity of Energized 765-kV Lines. IEEE Paper No. T72551-0.

Galli, A. E., C. F. Leck, and R. T. Foreman. 1976. "Avain Distribution Pattern in Forest Islands of Different Sizes in Central New Jersey." Auk 73(1):131-132.

Gilluly, Sam. September 1, 1977. "State Enjoying Tourism Boom." Sanders County Ledger. Thompson Falls, Montana.

Goodwin, J. G., Jr. 1975. Big Game Movement Near a 500-kV Transmission Line in Northern Idaho. A study by the Western Interstate Commission for Higher Education for the Engineering and Construction Division, Bonneville Power Administration.

Granite County Planning Board. No date. Granite County Land Use Plan.

Griffith, Dennis B. (BPA WICHE Intern). Summer 1977. Personal communication with John Baglien.

Gunter, G. 1976. "On the Reluctance of Gulls to Fly under Objects." Auk 73(1):131-132.

Hall, Larry (Planner, Flathead Indian Reservation, Montana). October 12, 1977. Personal communication with Toni Blackburn/Elliot.

Hash, Howard (Associate Researcher, Idaho Cooperative Wildlife Research Unit, Moscow). July 1977. Telephone conversation with John Baglien.

Haynam, Karen Craighead and Jay S. Sumner. 1977. Peregrine and Prairie Falcon Nesting Survey and Habitat Analysis - Lolo National Forest. U. S. Forest Service Contract Number 263-0046.

Hehn, E. R. 1973. Crop Survey for Colstrip Project Transmission Line. Colstrip-Consultant Reports for Westinghouse Environmental Analysis. WESD/AEA 1973.

Herrero, S. H. 1972. "Aspects of Evolution and Adaption in American Black Bears, and Brown and Grizzly Bears of North America." Bears: Their Biology and Management. S. Herrero (ed.). International Union for Conservation of Nature and Natural Resources, Morges, Switzerland. 371 p.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. Thompson. 1955-69. Vascular Plants of the Pacific Northwest. (5 vol.). University of Washington Press, Seattle, Washington.

Hoffman, R. S. and D. L. Pattie. 1968. A Guide to Montana Mammals: Identification, Habitat, Distribution and Abundance. University of Montana Printing Service, Missoula. 133 p.

Hoffman, R. S. , D. L. Pattie, and J. F. Bell. 1969. "The Distribution of Some Mammals in Montana - II Bats." Journal of Mammalogy. 51:737-741.

Hoffman, R. S., P. L. Wright, and F. E. Newby. 1969. "The Distribution of Some Mammals in Montana. I. Mammals Other than Bats." Journal of Mammalogy. 50:579-604.

Hornbeck, James W. and C. Anthony Federer. 1975. "Effects of Management Practices on Water Quality and Quantity: Hubbard Brook Experimental Forests, New Hampshire." Reprinted from Municiple Watershed Management Symposium Proceedings. USDA Forest Service General Tech. Report. NE-13:58-65. Durham, New Hampshire. 8 p.

Hornbeck, J. W., R. S. Pierce, and C. A. Federer. 1970. "Streamflow Changes after Forest Clearing in New England." Water Resources Research, Volume 6, No. 4. Reprinted by USDA Northeastern Forest Experiment Station. Durham, New Hampshire. 1124-1131 pp.

Hornorker, M. G. 1970. An Analysis of Mountain Lion Predation Upon Mule Deer and Elk in the Idaho Primitive Area. Wildlife Monograph, No. 21. 39 p.

Hunt, R. A. 1972. Some Field and Court Case Experiences with Waterfowl and Electrical Powerlines. Midwestern Wildlife Conference, Des Moines, Iowa. December 10-13.

Institute of Electrical and Electronics Engineers (IEEE). 1972. "Part I - Hazards and Effects." IEEE Transactions Power Apparatus and Systems, Vol. PAS 91, No. 2 March/April 1972. Working Group on Electrostatic and Electromagnetic Effects of Overhead Transmission Lines.

Institute of Electrical and Electronics Engineers (IEEE). 1977. National Electrical Safety Code. New York, N. Y. 346 pp.

Johnson, Johnson, and Roy. 1970. Transmission and Distribution, Right-of-Way Selection and Development. Prepared for Consumer's Power Company, Jackson, Michigan. 55 pp.

Johnson, Maxine C. 1972. "Wood Products in Montana - A Special Report on the Industry's Impact on Montana's Income and Employment." Montana Business Quarterly, Volume 10, No. 2. Bureau of Business and Economic Research, University of Montana, Missoula.

Jones and Jones. 1976. Measuring the Visibility of High-Voltage Transmission Facilities in the Pacific Northwest. For the Bonneville Power Administration, Portland, Oregon. 55 p.

Jones and Jones. 1976. Visual Impact of High-Voltage Transmission Facilities in Northern Idaho and Northwestern Montana. For the Bonneville Power Administration, Portland, Oregon. 157 p.

Jonkel, Charles. (Principle Researcher, Border Grizzly Study Project, University of Montana, Missoula). August 1977. Telephone conversation with John Baglien.

Jonkel, C. J. and I. M. Cowan. 1971. The Black Bear in the Spruce-fir Forest. Wildlife Monograph No. 27.

Jonkel, C., G. Joslin, C. Servheen, and S. Mealey. Undated. Grizzly Bear "Critical Habitat." Border Grizzly Project. Special Report No. 4. University of Montana, Missoula. 8 p. (mimeo).

Joppa, S. 1974. Scenic Rating Criteria - Transmission Study - Colstrip to Hot Springs. Montana Department of Fish and Game, Helena.

Kaschke, Marvin R. (Refuge Manager, National Bison Range, Moiese, Montana). July 11, 1974. Personal communication with Jack Fisher.

Keesey, J. C. and F. S. Letcher. 1970. "Human Thresholds of Electric Shock at Power Transmission Frequencies." Archives of Environmental Health. 21:547-552.

Kitchings, J. T., H. H. Shugart, and J. D. Story. 1974. Environmental Impacts Associated with Electric Transmission Lines. Oak Ridge National Laboratory, Operated by Union Carbide Corporation for the U.S. Atomic Energy Commission (Publication #591). Oak Ridge, Tennessee. 104 p.

Kimbark, E. W. Power System Stability, Volume I 1948, Volume II 1950, Volume III 1956. John Wiley & Sons, Inc., New York.

Knight, R. R. 1967. Elk Population Trends, Food Habits, and Range Relationships in the Sun River Area. Montana Department of Fish and Game, Helena. Project No. W-98-R-6&7. Job No. I-4.

Knight, R. R. 1975. Yellowstone Grizzly Bear Investigations: Annual Report of the Interagency Study Team. U.S. National Park Service Misc. Report No. 9. 46 p.

Knoche, K. G. 1968. Ecology of the Rattlesnake Creek, Montana, Mule Deer Winter Range. M. S. Thesis. University of Montana, Missoula. 152 p.

Knowlton, F. F. 1960. "Food Habits, Movements, and Population of Moose in the Gravelly Mountains, Montana." Journal of Wildlife Management. 241(1):53-57.

Koehler, G. M., W. R. Moore, and A. R. Taylor. 1975. "Preserving the Pine Marten: Management Guidelines for Western Forests." Western Wildlands. Reprinted by: Montana Forest and Conservation Experiment Station, Missoula. 6 p.

Lantz, Richard L. 1971. Guidelines for Stream Protection in Logging Operations. Oregon State Game Commission. Portland, Oregon. 29 p.

Lee, Jack M., Jr. 1978. Effects of Transmission Lines on Bird Flights: Studies of Bonneville Power Administration Lines. Paper presented at the Workshop on Impact of Transmission Lines on Migratory Birds, Jan. 31, Feb. 1, and 2, 1978. Oakridge, Tennessee.

Lee, J. M. 1977. Transmission Lines and Their Effect on Wildlife. Paper presented at: Oregon Chapter of the Wildlife Society, Kah-Nee-Tah. Bonneville Power Administration, Portland, Oregon. 25 p.

Lee, J. M. and D. B. Griffith. 1977. Transmission Line Audible Noise and Wildlife. Paper presented at: the Ninth International Congress on Accoustics, Madrid, Spain. Bonneville Power Administration, Portland, Oregon. 58 p.

Loftness, M. O. A Practical Handbook for the Location, Prevention, and Correction of Television Interference from Overhead Power Lines. Publication of the Bonneville Power Administration, Portland, Oregon. 101 p.

Lovegrove, Robert (Economist with USDA Forest Service, Missoula, Montana). August 18, 1977. Personal communication with Jack Fisher.

Lyon, L. J. 1975. Coordinating Forestry and Elk Management in Montana: Initial Recommendations. 40th North American Wildlife and Natural Resources Conferences of Wildlife Management Institute. Washington, D.C.

Mackie, R. J. 1970. Range Ecology and Relations of Mule Deer, Elk, and Cattle in the Missouri River Breaks, Montana. Wildlife Monograph No. 20.

Marcum, L. 1975. Summer-Fall Habitat Selection and Use by a Western Montana Elk Herd. Ph.D. Dissertation, University of Montana, Missoula. 188 p.

Mardirosian, Charles A. 1976. "Mining Districts and Mineral Deposits of Montana." (Map).

Martin, D. (BLM Archeologist, Billings, Montana). October 14, 1977. Personal communication with John Pyrch.

Martin, N. and D. Pyrah. 1971. "Sage Grouse." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 135-141 pp.

McBryde, Bruce (U.S. Fish and Wildlife Service, Washington, D.C.). 1977. Telephone Communication with Greg Berry.

McGahan, J. 1967. "Quantified Estimates of Predation by a Golden Eagle Population." Journal of Wildlife Management. 31(3):496-501.

McLean, A. 1971. "Utilization of the Major Plant Communities in the Similkameen Valley, British Columbia." Journal of Range Management, Volume 24.

Mealey, S. 1975. The Natural Food Habits of Free-Ranging Grizzly Bears in Yellowstone National Park, 1973-1974. M. S. Thesis. Montana State University, Bozeman. 158 p.

Mealey, S., C. J. Jonkel, and R. Demarchi. 1977. Habitat Criteria for Grizzly Bear Management. Presented at: XIIIth International Congress of Game Biologists. Atlanta, Georgia.

Meagher County Planning Board. 1977. Meagher County Comprehensive Plan. Meagher County, Montana.

Megahan, Walter F. 1974. Erosion Over Time on Severly Disturbed Granitic Soils: A Model. USDA Forest Service Research Paper INT-156. Intermountain Forest and Range Experiment Station, Ogden, Utah.

Megahan, W. G. and W. J. Kidd. 1972. "Effects of Logging and Logging Roads on Erosion and Sediment Deposition from Stegs Terrain." Journal of Forestry. Society of American Foresters. Washington, D. C. 136-141 pp.

Millar, C. E., L. M. Turk, and H. D. Foth. 1965. Fundamentals of Soil Science, Fourth Edition, John Wiley and Sons, Inc., New York. 491 p.

Miller, R. H. 1970. Power System Operation. McGraw-Hill Book Company New York.

Missoula City/County Planning Board. 1975. Meagher County Comprehensive Plan. Missoula, Montana.

Mitchell, J. K., K. Greer, and R. Weckwerth. 1971. "Furbearers." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 196-205 pp.

Moe, R. A., G. A. Nielsen, and R. T. Choriki. 1971. Soil Crust Studies. Research Report No. 6. Montana Agricultural Experiment Station, Montana State University, Bozeman.

Montana Agricultural Experiment Station and Cooperative Extension Serivce. (MAESCES). 1973. Montana Agricultural Basic Facts. Bulletin 664. Montana State University, Bozeman.

Montana Department of Agriculture and Statistical Reporting Service - USDA. (MDASRS). 1976. Montana Agricultural Statistics, Volume XVI. County Statistics, 1974 and 1975.

Montana Department of Community Affairs. 1975. County Profiles. Research and Information Systems Division.

Montana Department of Community Affairs. 1976. Economic Conditions in Montana, A Report to the Governor. Research and Information Systems Division.

Montana Department of Fish and Game (MDFG). Statewide Survey of Montana Residents, 1971-1972.

Montana Department of Fish and Game (MDFG). 1973. Montana Statewide Outdoor Recreation Plan, Volumes 1-3. Parks and Recreation Division.

Montana Department of Fish and Game (MDFG). 1975. State of Montana Administrative Code. Recreation and Parks Section 12-2.6 (1-s2670).

Montana Department of Fish and Game (MDFG). 1977. Map of Wildlife Management Areas.

Montana Department of Fish and Game (MDFG). No date a. Classification of Montana Fishing Streams. Stream Classification Committee.

Montana Department of Fish and Game (MDFG). No date b. State Parks Brochure.

Montana Department of Health and Environmental Sciences (MDHES). 1974. Water Quality Standards. MAC 16-2. 14(10)-s14480.

Montana Department of Health and Environmental Sciences (MDHES). 1975. Clean Air Act of Montana (with revisions, effective as of July 1, 1975).

Montana Department of Health and Environmental Sciences (MDHES). 1977. Annual Air Quality Data Summary for Montana 1976. Report prepared by James W. Gelhous, Environmental Science Division, Helena.

Montana Land Use Plan. 1977. Butte-Silver Bow, Project No. P-38. Department of Urban and Regional Planning.

Montana Department of Natural Resources and Conservation (DNRC). 11/23/1977. "Colstrip Transmission Project Construction Guidelines for 500 kV Colstrip to Hot Springs Transmission Lines - Draft." 19 p.

Montana Legislative Council. 1976. Montana's District Courts. Interim Study by the Subcommittee on Judiciary. State Capital, Helena.

Montana Power Company (MPC). 1977. Colstrip Transmission Project Construction Guidelines for 500 kV Colstrip to Hot Springs Transmission Lines. Main Engineers. Portland, Oregon 11 pp.

Montana State University (MSU). 1973. Vegetative Rangeland Types in Montana. Bulletin 671. Department of Animal and Range Sciences, Montana Agricultural Experiment Station, Bozeman.

Montana Water Quality Bureau. 1975a. Water Quality Inventory and Management Plan, Musselshell River Basin, Montana (Preliminary Draft). Montana Department of Health and Environmental Services. Helena, Montana. 121 p.

Montana Water Quality Bureau 1975b. Water Quality Inventory and Management Plan, Upper Clark Fork River Basin, Montana. Montana Department of Health and Environmental Sciences, Helena. 148 p.

Montana Water Quality Bureau. 1976a. Water Quality in Montana. Montana Department of Health and Environmental Sciences, Helena. 36 p.

Montana Water Quality Bureau. 1976b. Water Quality Inventory and Management Plan, Lower Clark Fork River Basin, Montana. Montana Department of Health and Environmental Sciences, Helena. 129 p.

Montana Water Quality Bureau. 1976c. Water Quality Inventory and Management Plan, Upper Yellowstone River Basin, Montana. Montana Department of Health and Environmental Sciences, Helena. 153 p.

Montana Water Quality Bureau. 1977. Montana Water Pollution Control Program Plan for Federal Fiscal Year 1978. Montana Department of Health and Environmental Sciences, Helena. 76 p.

Morgan, M. 1975. "EHV Electric Fields: The New Radiation Scare." Electric Light and Power. March 24, 1975.

Morris, Mel. 1964. "Potential Vegetation Types of Montana." University of Montana. (Map)

Mount Helena City Park Development and Management Plan. No date. Revised Comprehensive Plan for Jurisdictional Area. Appendix one.

Mulloy, William T. 1958. A Preliminary Historical Outline for the Northwestern Plains. University of Wyoming Publications, Vol. 22, No. 1. Laramie, Wyoming.

Mundinger, J. G. 1976. "Population Ecology and Habitat Relationships of White-tailed Deer in a Coniferous Forest Habitat of Northwestern Montana." Montana Deer Studies: Progress Report 1975-1976. Montana Department of Fish and Game, Helena. 7-37 pp.

Mussehl, T., P. Schladweiler, and R. Weckworth. 1971. "Forest Grouse." Game Management in Montana. T. W. Mussehl and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 142-151 pp.

Nature Conservancy and Bureau of Outdoor Recreation (NC&BOR). 1976. The Blackfoot River, a Conservation and Recreation Management Plan.

Northwest Planners, Inc. 1973. Deer Lodge County Comprehensive Planning Program County-wide Comprehensive Plan. Prepared for Deer Lodge County Planning Board.

On, D. and B. J. Losensky. Undated. Ecoclass Identification for Region One. U.S. Forest Service, Flathead National Forest, Kalispell, Montana. 11 p. (mimeo).

Packer, Paul E. 1967. "Criteria for Designing and Locating Logging Roads to Control Sediment." Forest Science, Volume 13, No. 1. 2-18 pp.

Payne, G. F. 1973. Vegetative Rangeland Types in Montana. Bulletin No. 671. Montana Agriculutral Experiment Station, Bozeman. 16 p.

Perry, Eugene S. 1962. Montana in the Geologic Past. Bulletin 26. Montana Bureau of Mines and Geology, Butte. 78 p.

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest Habitat Types of Montana. USDA Forest Service, General Tech. Report INT-34. Intermountain Forest and Range Experiment Station, Ogden, Utah.

Pierce, R. S., J. W. Hornbeck, G. E. Likens and F. H. Borman. 1970. "Effect of Elimination of Vegetation on Stream Water Quantity and Quality." Symposium on the results of research on representative and experimental basins, Wellington, N. Z., December 1970. Reprinted by USDA Northeastern Forest Experiment Station, Durham, New Hampshire.

Polk, C. 1974. Biological and Clinical Effects of Low Frequency Magnetic and Electric Fields. Charles C. Thomas (ed.). Springfield, Illinois. 345 pp.

Polk, C. 1974. Sources, Propagation, Amplitude, and Temporal Variation of Extremely Low Frequency (0-100Hz) Electromagnetic Fields. 21-48 pp.

Quenemoen, M. E. and L. S. Thompson. 1965. How to Estimate Land Value. Bulletin 327. Cooperative Extension Service, Montana State University, Bozeman.

Reynolds, H. V. 1969. Population Status of the Golden Eagle in South-Central Montana. M. S. Thesis. University of Montana, Missoula. 51 p.

Rognrud, M. and R. Janson. 1971. "Elk." Game Management of Montana. Mussehl, T. W. and F. W. Howell (eds.). Montana Department of Fish and Game, Helena. 36-51 pp.

Ross, Robert L., Earl P. Murray and June G. Haigh. July 1973. Soil and Vegetation Inventory of Near-Pristine Sites in Montana. USDA, Soil Conservation Service. Bozeman, Montana. 55 p.

Rumely, J. H. (Herbarium Curator and Plant Ecologist, Montana State University). June 1977. Telephone conversation with John Baglien.

Russell, E. W. 1973. Soil Conditions and Plant Growth. Tenth edition. Longman, London.

Sebo, S. A., J. T. Heibel, M. Frydman, and C. H. Shih. 1975. Examination of Ozone Emanations from EHV Transmission Line Corona Discharges. IEEE Paper No. F75 510-8.

Servheen, Chris (Associate Researcher, Border Grizzly Study Project, University of Montana, Missoula). September 1977. Telephone conversation with John Baglien.

Schallenberger, A. 1977. Review of Oil and Gas Exploitation Impacts on Grizzly Bears. Presented at: Fourth International Conference on Bear Research and Management. Kalispell, Montana.

Sharrock, Floyd (Archeologist, USFS Region 1, Missoula, Montana). September 1977. Personal communication with Mike Newson and John Pyrch.

Sharrock, Susan R. and James D. Keyser. 1974. Culture History of the Missouri River From Fort Benton, Montana, to the Garrison Reservoir, North Dakota: An Inventory of Prehistoric and Early Historic Sites. Special Report from the University of Montana Statewide Archeological Survey, Missoula, Montana.

Shea, Mike (Division of Land Administration, Montana Department of State Lands). 1977. Personal communication with Jack Fisher. State of Montana, Department of State Lands.

Snow, C. 1972. Blackfooted Ferret, Mustela nigripes. Habitat Management Series for Endangered Species. No. 2. Bureau of Land Management, U.S. Department of the Interior. Portland, Oregon. 23 p.

Society for Range Management (SRM). 1974. Glossary of Terms Used in Range Management.

Sol, Colonel Joe R., Chief, Highway Patrol Bureau. Montana Drivers Manual. Montana State Department of Justice. Helena, Montana.

Stevenson, W. D. Jr. 1962. Elements of Power System Analysis. McGraw-Hill Book Company, Inc., New York.

Stout, J. I. and G. W. Cornwell. 1976. "Non-hunting Mortality of Fledged North American Waterfowl." Journal of Wildlife Management. 40(4):681-693.

Sumner, J. (Arlee, Montana, Junior High School Teacher). 1974. Personal communications as cited in DNRC/DEIS 1974.

Swantston, Douglas N. 1971. "Judging Impact and Damage of Timber Harvesting to Forest Soils in Mountainous Regions of Western North America." Western Reforestation Coordinating Committee, Western Forestry and Conservation Association, November, 1971. Portland, Oregon. 6 p.

Takagi, T. and T. Muto. 1971. Influences Upon Human Bodies and Animals of Electrostatic Induction Caused by 500 kV Transmission Lines. Tokyo Electric Power Co., Inc., Tokyo, Japan. 25 p.

Taylor, Dee C. 1960. "Montana's Earliest Hunters." Archeology in Montana, Vol. 5, No. 4, pp. 11-12. Bozeman, Montana.

Taylor, Dee C. 1969. "The Wilsall Excavations: An Exercise in Frustration." Proceedings of the Montana Academy of Sciences, vol. 29, pp. 147-150.

Thomas, J. W., C. Maser, and J. E. Rodiet. 1977. "Edges - Their Interspersion, Resulting Diversity and Its Measurements." Forest - Wildlife Relationships in the Blue Mountains of Washington and Oregon. J. W. Thomas (ed.). U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Thompson, L. S. 1977. Environmental Impacts of High Voltage Power Lines, II. Impacts to Wildlife. Draft report for: Montana Department of Natural Resources and Conservation, Energy Planning Division. 20 p.

Toole, K. Ross. 1959. Montana: An Uncommon Land. Norman: University of Oklahoma Press.

Troughton, Arthur. 1962. The Roots of Temperate Cereals (Wheat, Barley, Oats and Rye). Mimiographed Pub. No. 2. Commonwealth Bureau of Pastures.

USDA Forest Service. 1969. "Eagles and Osprey." Wildlife Habitat Improvement Handbook. Washington, D.C.; Sec. 44.21.

USDA Forest Service. 1971. Drainage and Revegetation Standards. Lolo National Forest. Missoula, Montana. 24 p.

USDA Forest Service. 1972. Soil Survey of St. Regis-Ninemile Area, Montana. Region 1, Missoula, Montana. 289 p.

USDA Forest Service. 1973a. Forest Hydrology: Hydrologic Effects of Vegetation Manipulation. Northern Region, Missoula, Montana. 209 p.

USDA Forest Service. 1973b. Multiple Use Plan-North Bridger Planning Unit. Final Environmental Statement. Gallatin National Forest. Bozeman, Montana. 36 p.

USDA Forest Service. 1974a. Multiple Use Plan - Elkhorn Planning Unit. Final Environmental Statement. Helena National Forest. Helena, Montana. 231 p.

USDA Forest Service. 1974b. Multiple Use Plan, Gold Creek Planning Unit. Final Environmental Statement. Lolo National Forest. Missoula, Montana. 162 p.

USDA Forest Service. 1974c. National Forest Landscape Management, Volume Two, Chapter 1, The Visual Management System. Agriculture Handbook No. 462. U.S. Government Printing Office. 47 p.

USDA Forest Service. 1974d. Contract Provisions for Powerline Construction. Lolo National Forest. Missoula, Montana. 34 p.

USDA Forest Service. 1975. National Forest Landscape Management, Volume Two, Chapter 2, Utilities. Agricultural Handbook No. 478.

USDA Forest Service. 1976a. Land Suitability Pattern for Electrical Transmission Lines. Northern Region, Missoula, Montana. 75 p.

USDA Forest Service. 1976b. Multiple Use Plan - Basin Planning Unit. Final Environmental Statement. Deerlodge National Forest. Butte, Montana. 156 p.

USDA Forest Service. 1976c. Magpie Confederate Planning Unit. Draft Environmental Statement. Helena National Forest. Helena, Montana. 181 p.

USDA Forest Service. 1976d. Land Use Plan, Colorado-Unionville-Travis Planning Unit. Draft Environmental Statement. Helena National Forest. Helena, Montana. 248 p.

USDA Forest Service. 1977a. Ophir-Dog-McDonald Pass Planning Unit. Final Environmental Statement. Helena National Forest. Helena, Montana. 241 p.

USDA Forest Service. 1977b. Management Plan, Placid-Blanchard Planning Unit. Draft Environmental Statement. Lolo National Forest. Missoula, Montana. 96 p.

USDA Forest Service. 1977c. Land Management Plan, Ninemile-Mill Planning Unit. Final Environmental Statement. Lolo National Forest. Missoula, Montana. 139 p.

USDA Soil Conservation Service. 1971. Soil Survey - Powder River Area.

USDA Soil Conservation Service. 1974. Soil Taxonomy. Agriculture Handbook No. 436. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 754 p.

USDA Soil Conservation Service. 1975a. 1958-1972 Average Annual Snowfall in Inches. Montana Snow Survey Unit, Bozeman. (Map).

USDA Soil Conservation Service. 1975b. "Procedure for Computing Sheet and Rill Erosion on Project Areas." Technical Release No. 51. Washington, D.C. 16 p.

USDA Soil Conservation Service. August 16, 1977. "Land Inventory and Monitoring." Memo 3, revision 1.

USDA Soil Conservation Service and Montana Agriculture Experiment Station. 1967. Soil Survey of Treasure County, Montana. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 173 p. plus maps.

USDA Soil Conservation Service and Montana Agricultural Experiment Station. 1977. Soil Survey of Broadwater County Area, Montana. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 83 p. plus maps.

USDA Soil Conservation Service, USDI Bureau of Indian Affairs, Montana Agricultural Experiment Station. 1972. Soil Survey of Yellowstone County, Montana. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 133 p. plus maps.

USDI. 1973. Bureau of Outdoor Recreation Manual. 660.2.2H(I).

USDI. 1976. Federal Register. Volume 40, No. 117. 24524-24570 pp.

USDI. 1976. Assessment of the Alternative Power Transmission Corridors for the Dickey/Lincoln School Hydroelectric Project.

USDI. Bureau of Land Management. 1975. The Need for a National System of Transportation and Utility Corridors.

USDI. 1977a. Colstrip Transmission Work Management Plan for Preparation of Transmission Environmental Report.

USDI. 1977b. "Endangered and Threatened Wildlife and Plants." Federal Register, Volume 42, No. 135. 36420-36431 pp.

USDI-BPA. 1974. Draft Environmental Statement, General Construction and Maintenance Program.

USDI-USDA. 1970. Environmental Criteria for Electric Transmission Systems. U.S. Government Printing Office. 52 pp.

U.S. Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with Adequate Margin of Safety.

U.S. Environmental Protection Agency. 1975. Logging Roads and Protection of Water Quality. U.S. Environmental Protection Agency, Region X. Seattle, Washington. 312 p.

U.S. Fish and Wildlife Service. 1976. "Endangered and Threatened Wildlife and Plants." Federal Register (41 Fr 24524-24572). U.S. Government Printing Office, Washington, D.C.

U.S. Geological Survey. 1976. Water Resources Data for Montana Water Year 1975. Report No. USGS/WRD/HD/-761040, Water Data Report MT-75-1. Helena, Montana.

Wacker, G. 1977. Safety Considerations in Operating Sprinkler-Irrigation Systems Near High-Voltage Transmission Lines. Prepared for the Energy Resources Conservation Board. Calgary, Alberta.

Watts, C. R., F. G. Feist, A. D. Schallenberger, and G. L. Erickson. 1973. Upland Game Bird Survey and Inventory, District 4 (Native). Project No. W-130-R-4. Job No. II-4. Montana Department of Fish and Game, Helena.

Wechworth, R. 1971. "Black Bear." Game Management in Montana. Mussehl and Howell, eds. Montana Deparment of Fish and Game. 115-119 pp.

Wentland, H. J. 1968. Summer Range Habits of the Pronghorn Antelope in Central Montana with Special Reference to Proposed Sagebrush Control Study Plots. M. S. Thesis. Montana State University, Bozeman.

Western Systems Coordinating Council. 1973. Reliability Criteria for System Design.

Westinghouse Environmental Systems Department (WESD/AEA). 1973. Colstrip Generation and Transmission Project. Applicants Environmental Analysis. Westinghouse Environmental Systems.

Wipperman, A. H., R. R. Martinka, J. K. Constan. 1973. "Smith River Drainage Inventory and Planning Investigation." Federal Aid to Fish and Wildlife Restoration Project FW-1-R-3.

Wirth Associates. 1977. Colstrip to Hot Springs Visual Resource Analysis. Consultant report to Bonneville Power Administration for Colstrip Transmission Environmental Report.

Zimmerman, R. P. and L. T. Kardos. 1961. "Effect of Bulk Density on Root Growth." Soil Science. 91:280-288.

ADDITIONAL REFERENCES

Bancroft, Hubert H. 1890. The Works of Hubert Howe Bancroft, Volume XXXI History of Washington, Idaho, and Montana, 1845-1889. San Francisco: The History Co., Publishers.

Bromander, M. 1967. Lightning Protection of Transmission Lines. Bonneville Power Administration, Portland, Oregon.

Chase, Craig L. 1976. Petroleum Supply System (Crude Oil and Finished Product). Operations Manual Part 200, Federal Energy Administration, Region X, Seattle, Washington.

Cumin Associates. 1976. Rosebud County, Montana, General Plan. Billings, Montana.

Howard, Needles, Tammen and Bergendoff (HNTB). 1971. Butte-Silver Bow, Montana, Land Use Plan. Prepared for Butte-Silver City-County Planning Board.

Institute of Electrical and Electronics Engineers, Inc. 1976. Analysis and Control of Subsynchronous Resonance, IEEE Catalog Number 76CH1066-0-PWR. IEEE Service Center, Piscataway, NJ.

Johnson, W. J. 1970. Transmission and Distribution Right-of-Way Selection and Development. For Consumers Power Company, Jackson, Michigan. 55 p.

Lake County Planning Board. 1977. Model Land Use Plan for Citizen Involvement. (Unpublished draft).

Mathisen, J. E. 1968. "Identification of Bald Eagle and Osprey Nest in Minnesota." Loon 40(4):113-114.

Malouf, Carling. 1952. Economy and Land Use by the Indians of Western Montana. Missoula, Montana.

Megahan, Walter F. 1975. "Sedimentation in Relation to Logging Activities in the Mountains of Central Idaho." Proc. Sediment-yield Workshop, USDA Sediment Lab., Oxford, Mass., Nov. 28-30, 1972. U.S. Agriculture Res. Service Rep. ARS-S-40. 285 p.

Montana Department of Fish and Game (MDFG). 1974. Montana Historic Preservation Plan with Historic Sites Compendium. Second edition, Volumes I and II.

Montana Department of Fish and Game (MDFG). 1976. Statewide Non-Urban Developed Recreation Site Inventory.

Montana Department of Health and Environmental Sciences. 1976. Annual Air Quality Data Summary for Montana, 1975. Air Quality Bureau, Helena.

Montana Department of Highways, Planning and Research Bureau. 1976. Traffic by Sections.

Montana Department of Highways, Planning and Research Bureau. 1976. Montana Federal Aid Systems - Interstate, Primary, Secondary (1"=10 miles).

Montana Department of Labor and Industry. 1976. Montana's 14 Major Labor Market Areas. Research and Analysis Section, Employment Security Division.

Montana Superintendent of Public Instruction. 1975. 1975-76 Montana Education Directory.

Montana Water Resources Board. Undated. An Atlas of Water Resources in Montana by Hydrologic Basins. Inventory Series Report No. 11.

Northwestern Montana Health Planning Council. 1975. Northwestern Montana Health Systems Plan. Missoula, Montana.

Ramirez, P. 1977. Small Mammal Populations in Different-aged Clearcuts and Uncut Forests in Northwestern Montana. M. S. Thesis. University of Idaho, Moscow. 73 p.

Revised Comprehensive Plan for Helena Jurisdictional Area. No date. No author.

Robinette, G. O. 1973. Energy and Environment. Kendall/Hunt Publishing Company. 301 p.

Smith, Charline G. 1974. Appraisal of Archeological Potential of the Transmission Line Study Area. Submitted to the USDI Bureau of Land Management from the University of Montana.

Smithsonian Institution. 1975. Report on Endangered and Threatened Plant Species of the United States. House Document 94-51. Washington, D.C.

Southard, A. R. 1973. Soils in Montana. Montana Agricultural Experiment Station and Montana State University Bulletin 621. Bozeman, Montana. 42 p.

Southwestern Areawide Health Planning Council. 1975. Comprehensive Health Plan. Helena, Montana.

Subcommittee on Judiciary, Montana's District Courts. 1976. A Report to the Forty-fifth Legislature.

Taylor, M. C., D. L. Herbert, and K. R. Suta. 1975. Prices Received and Prices Paid by Montana Farmers and Ranchers, 1964-1974. Bulletin 636 (Revised). Montana Agricultural Experiment Station, Montana State University, Bozeman.

Toole, K. Ross. 1976. The Rape of the Great Plains. Atlantic Monthly Press Book; Boston: Little, Brown, and Company.

USDA Forest Service. 1973. National Forest Landscape Management, Volume One. Agriculture Handbook No. 434. U.S. Government Printing Office. 76 p.

USDA Forest Service. 1977a. National Forest Landscape Management, Roads Volume 2, Chapter 4. Agricultural Handbook No. 483.

USDA Forest Service. 1977b. National Forest Landscape Management, Range Volume 2, Chapter 3. Agricultural Handbook No. 484.

USDA Forest Service. 1977c. Central Montana Planning Area Guide, Review Draft. Northern Region. Missoula, Montana. 172 p.

USDA Forest Service. Undated. "Visual Absorption Capability," (Draft). 21 p.

USDC National Oceanic and Atmospheric Administration. 1977. Climate of Montana. Climatography of the Central States, No. 60. National Climate Center.

USDC National Oceanic and Atmospheric Administration. 1976. Sectional Aeronautical Chart-Billings, Montana. Washington, D.C.

USDI Bureau of Land Management. 1975. Manual 6300-Visual Resource Management. 10 p.

USDI Bureau of Land Management. 1975. Manual 6310-Visual Resource Inventory and Evaluation. 20 p.

USDI Bureau of Land Management. 1975. Manual 6320-Visual Resource Contrast Rating. 9 p.

USDI Bureau of Land Management. In process. Manual 6300-Environmental Assessment for Visual Resources - (Draft). 10 p.

USDI Bureau of Land Management. 1977. Final Environmental Statement, Sierra Pacific Power Co., 230-345 kV Transmission Line, Orenano, Nevada - Hunt, Idaho, Appendix J. Nevada State Office.

USDI Bureau of Land Management. 1977. Sundesert Project Preliminary Draft Environmental Statement, Sections 2 and 4.

U.S. Environmental Protection Agency. 1974. Proposed Environmental Protection Agency Regulations Establishing Significant Harm and Emergency Action Levels for Protochemical Oxidants. 39FR9672.

U.S. Geological Survey. Topographic Maps 1:250,000-scale series: Billings, Bozeman, Butte, Chateau, Dillon, Forsyth, Great Falls, Hamilton, Hardin, Lewiston, Roundup, Wallace, and White Sulphur Springs quandrangles. U.S. Geological Survey, Denver, Colorado.

Western Interpretive Services. 1974. Historic Sites in the Colstrip to Hot Springs Transmission Line Study Area. Prepared for the Bureau of Land Management.

Williamson, D. N. 1976. "Visual Absorption Capability: Some Thoughts on the Current Status of the Art." Department of Landscape Architecture and Regional Planning, University of Massachusetts.

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